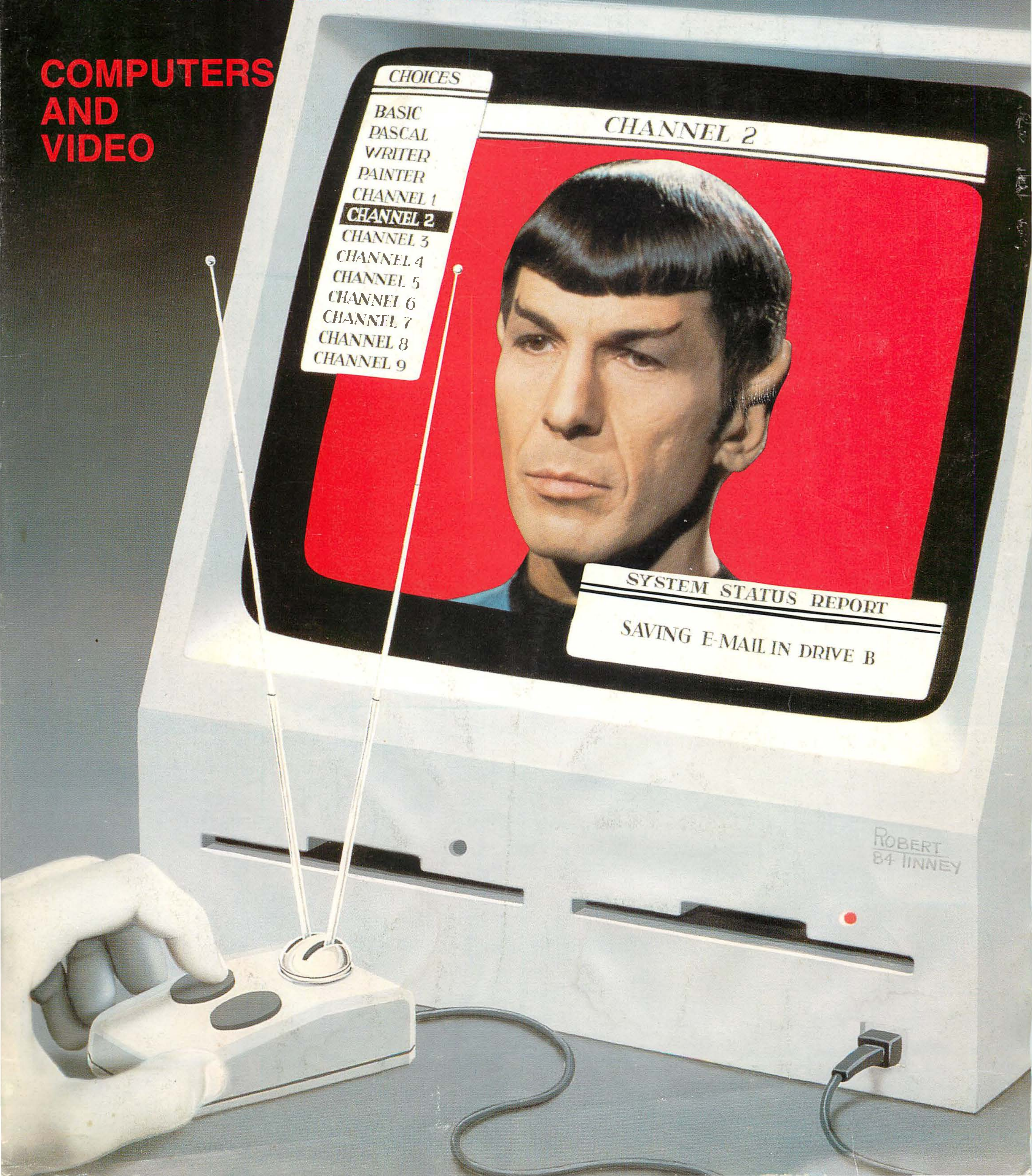
BYTE

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THE SMALL SYSTEMS JOURNAL

COMPUTERS AND VIDEO





Announcing a small imp

It's 12″ x 11¼″ x 2¼.″
It weighs less than 8 pounds.*
And costs less than $1,300.**
Yet with 128K, the new Apple® IIc Personal Computer is a lot bigger than it looks.

The IIc has a full-size keyboard.



Because it's inherited all the talents of the eminently talented Apple IIe:

The versatility to run over 10,000 different software programs.

The ironclad reliability of the first true VLSI motherboard.

And the artistic ability of 16 high-resolution colors.

The IIc also has some talents of its very own.

For instance, a switchable 80/40-character display.

Switchable QWERTY/Dvorak keyboard.



Thin, isn't it? Even with its built-in disk drive.

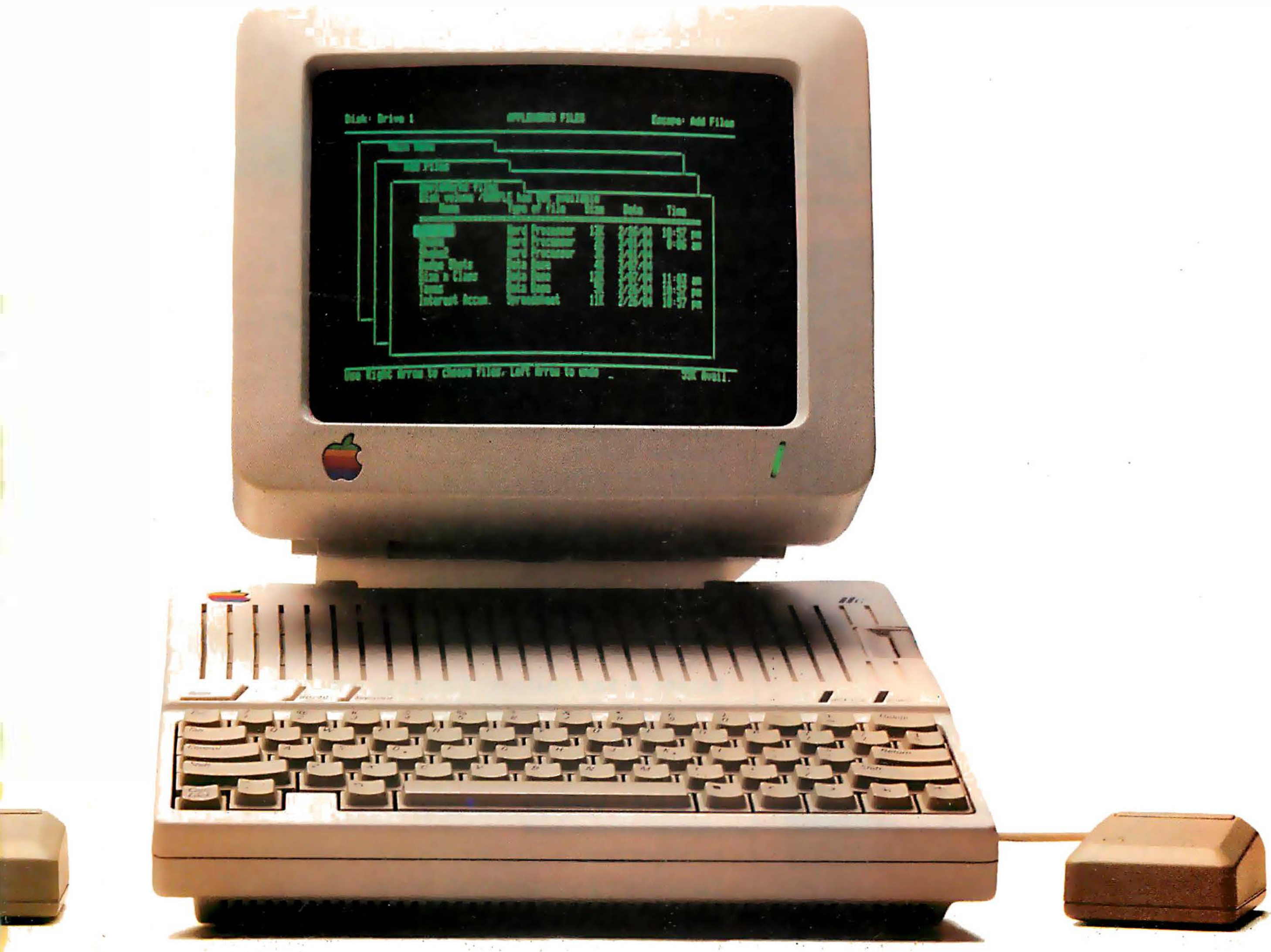
A built-in half-high 143K single-sided disk drive.

Built-in serial ports for modems, printers and an extra half-high drive.

Even built-in mousetronics so it's ready to use a mouse and all the new Apple II mouseware.

And our newest brainchild is certainly not an orphan.

You can grow it with a whole family of Apple II accessories and peripherals.



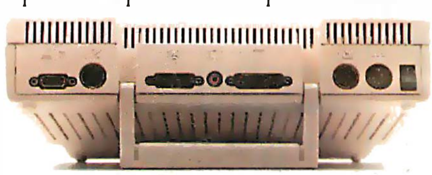
rovement on the Apple IIe.

Including the new Apple Scribe—Apple's first full-color print-on-anything printer for under $300, it can handle anything from business graphics to term papers.

The IIc's father, of course, is the granddaddy of the whole personal computer industry, the Apple IIe. Which, lest we forget, has quite a few improvements of its own this year.

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And the Apple IIe is still the most expandable personal computer there is.



Built-in ports for making all the right connections.

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Or a compact Apple II. As in IIc.

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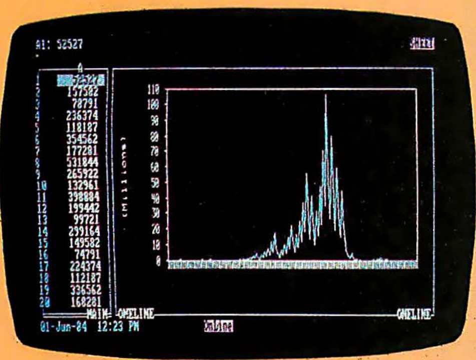
And tell them what size improvement you'd like.

** Don't asterisks make you suspicious as all get-out? Well, all this one means is that the IIc CPU alone weighs 7.5 pounds. The power pack, monitor, an extra disk drive, a printer and several bricks will make the IIc weigh more. Our lawyers were concerned that you might not be able to figure this one out for yourself. ** The FTC is concerned about price-fixing. So this is only a Suggested Retail Price. You can pay more if you really want to. Or less.*

For an authorized Apple dealer nearest you, call **(800) 538-9696.** *In Canada, call* **(800) 268-7796** *or* **(800) 268-7637.**

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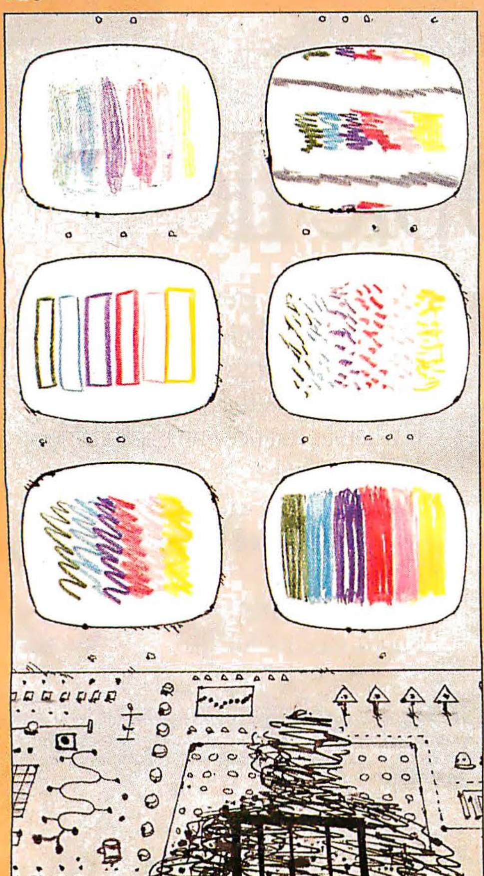
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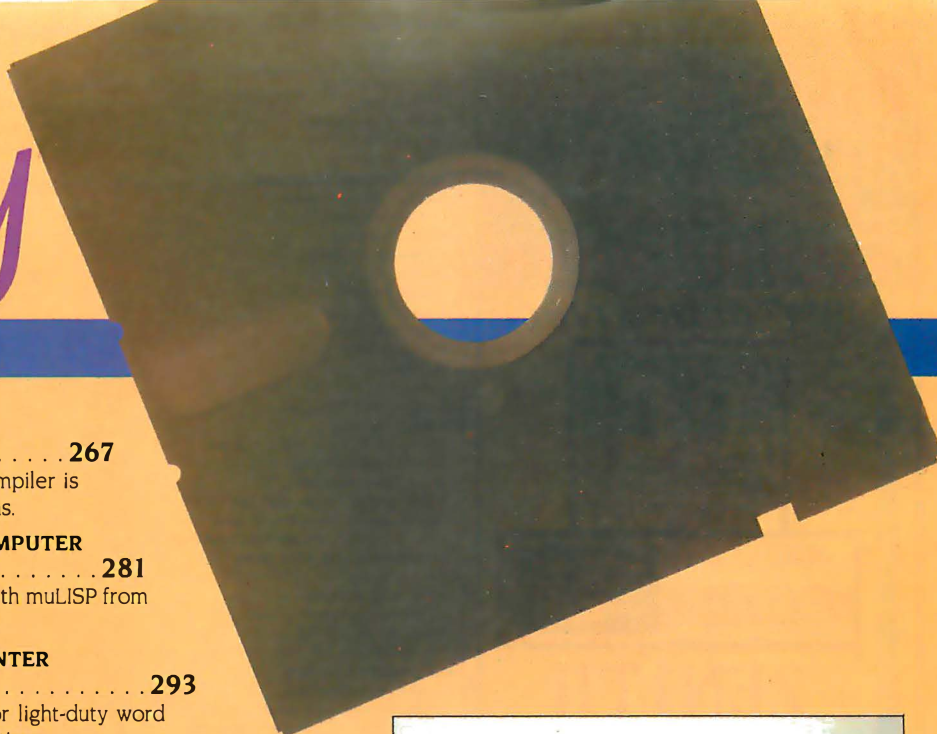


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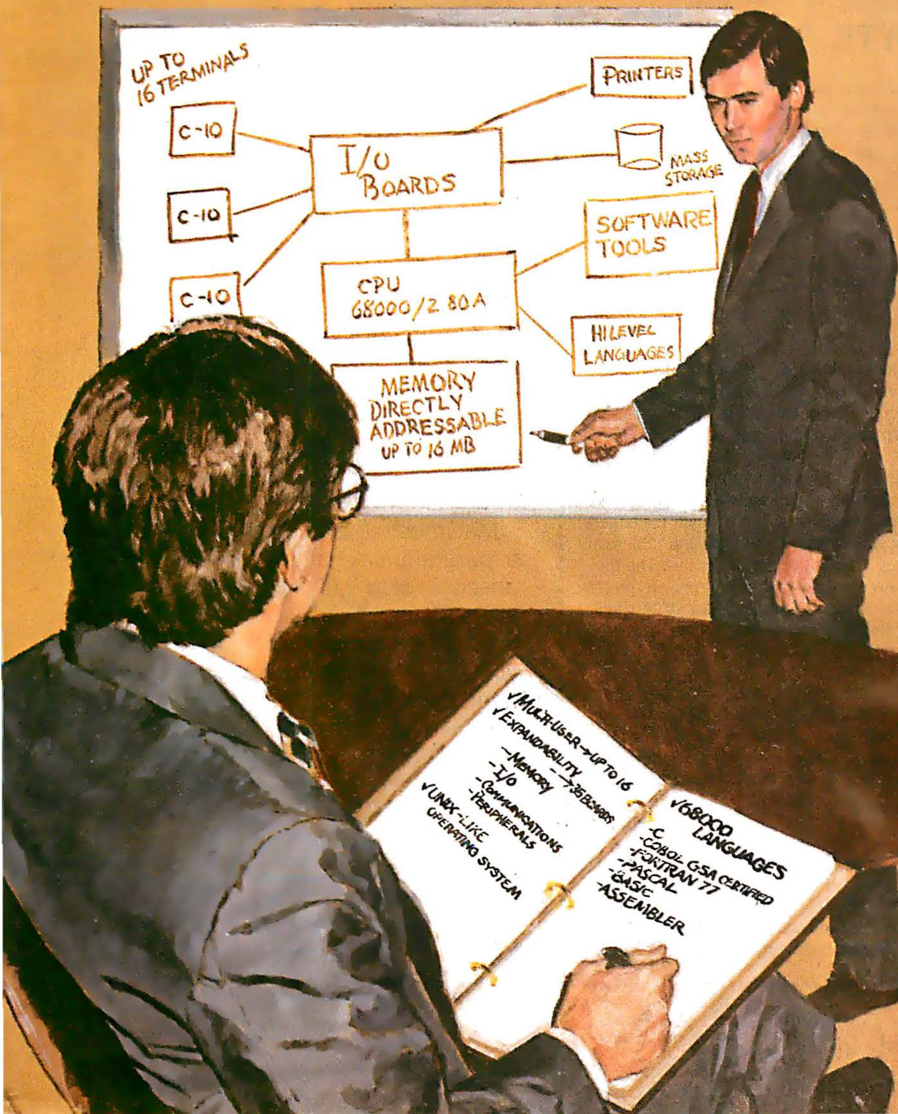
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Patronizing the Naive User

There is a lot of talk now about the naive user, what the naive user doesn't want, and the hazards from which the naive user must be protected. Unfortunately, some of the steps that computer companies take on behalf of the naive user show a misunderstanding of what "naive" means in this context.

Webster's New Collegiate Dictionary (Springfield, MA: G. & C. Merriam Company, 1981) defines "naive" as follows: "1: marked by unaffected simplicity: ARTLESS, INGENUOUS 2a: deficient in worldly wisdom or informed judgment; *esp*: CREDULOUS **b**: not previously subjected to experimentation or a particular experimental situation."

First-time users of computers are naive only in the last sense—they haven't been "subjected to" computers before. Yet many companies treat these new users as if they are simple-minded and deficient in judgment. In effect, such companies produce products that condescend to the people who buy them.

Apple's Macintosh is the best example of such a product. Macintosh will be nothing less than wonderful when it has two drives and more memory. It is without doubt the friendliest of today's computers. But it would be more friendly if it were less condescending.

Consider Macintosh's Reset button. Calling it a "programmer's switch" and hiding it inside the machine suggests that the naive user lacks sense enough to restart an appliance when all else fails. A recessed Reset button would have done the job nicely.

Macintosh's disk drive is more approachable than the Reset switch but is equally patronizing. Although the user can insert a disk whenever the drive is empty, the story changes once the disk is inside. The computer forces users—for their own good, of course—to pass a three-stage qualifying examination before the machine permits removal of a disk. First a user must select the icon of the disk, then select the File menu, and then select Eject. Only then does Macintosh consider returning the disk. The ensuing 10-second delay makes the user a humble petitioner before a mysterious and powerful computer. The whole process is especially annoying when the user has made the very human error of inserting the wrong disk in the first place.

Macintosh doesn't trust its users with a programming language, either. The absence of a built-in language gives users no means to attempt more direct control of the computer. Rather than inviting naive users to explore, this makes them think hard about paying extra to try something Apple Computer apparently believes they can't handle.

It's strange, in a way, to criticize Apple for going too far in the cause of friendliness. Most companies don't go far enough. This is a gentle reminder that truly friendly computers, like friendly humans, give their human friends credit for some intelligence.

—Phil Lemmons, Editor in Chief

Writing For BYTE

BYTE continues to solicit and publish articles and reviews that keep you informed about what's new and important in microprocessor-based technology, and many of our articles are still written by you, the people directly involved with the field we report on. Details on querying us about article, product-review, and book-review ideas are listed below. We also welcome submissions (typed and double-spaced, please) to our Letters to the Editor column. Please contact us, via the appropriate department at:

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You may also want to call or write us (send a stamped, self-addressed business envelope) for our current author guidelines.

Articles

Because our editorial needs are very specific and subject to change, we prefer receiving query letters instead of completed articles. A query letter should contain one or two pages explaining the subject to be covered, its importance to the BYTE reader, and the focus of the proposed article; it should also contain a one- or two-page outline and a tentative first two pages of the proposed article. Query letters should be addressed to the features editor.

If you send us a completed article, we need double-spaced printed versions of the main text (up to 25 numbered pages) and all listings, figures, and tables; please label all items and place all captions on a separate page. Photos should be 35 mm (or larger) transparencies or 5- by 7-inch (or larger) prints. If possible, we would also like to receive magnetic copies of the text, listings, and tables on Apple DOS, IBM PC, Kaypro, or 8-inch CP/M disks; we will pay an additional $20 for this. The files should be standard ASCII text files and should not contain any nonprintable characters; we prefer files that use carriage returns *only at the end of each paragraph*. You should also include a stamped, self-addressed return envelope of the appropriate size. Address these to the features editor.

Product Reviews

We frequently need good product reviewers and sometimes accept unsolicited reviews. BYTE product reviews must be fair, accurate, and comprehensive. Reviewers must have considerable experience in the microcomputer field. Writing experience is preferred but not required, and reviewers must have no financial connection to the company whose products are being reviewed. If you are interested in becoming a BYTE reviewer, send a letter to our product-review editor stating what computer products you own, what products you are interested in, and what writing experience you have.

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BYTE is always looking for qualified book reviewers. Submit queries and proposals accompanied by a resume, writing samples, or a list of computer-related interests and expertise to the book-review editor. Unsolicited book reviews also will be considered.

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Circuit-Board-Design Without the Tedium

smARTWORK™ lets the design engineer create and revise printed-circuit-board artwork on the IBM Personal Computer.

Forget tape. Forget ruling. Forget waiting for a technician, draftsman, or the CAD department to get to your project. smARTWORK™ software turns your IBM Personal Computer into a professional, high-quality drafting tool. It gives you complete control over your circuit-board artwork — from start to finish.

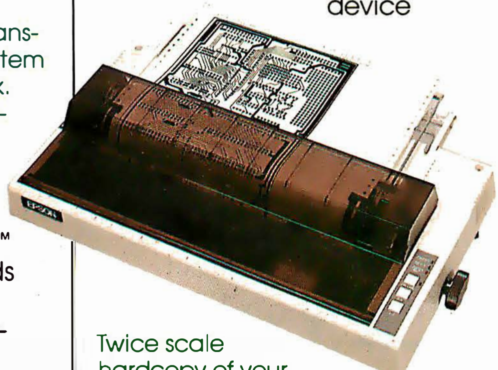


smARTWORK™ transforms your IBM PC into a CAD system for printed-circuit-board artwork. Display modes include both single-layer black and white and dual-layer color.

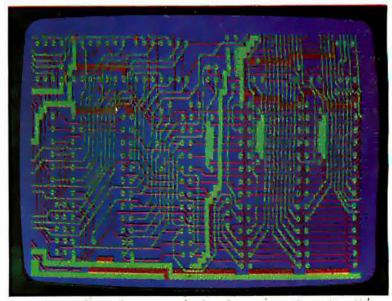
What makes smARTWORK™ so smart is that it understands electrical connections. Conductor spacing is always correct, lines don't become too narrow, and connecting lines do not intersect other conductors. smARTWORK™ can automatically find and draw the shortest route between two conductors. Or you can specify the route.

smARTWORK™ is the only low-cost printed-circuit-board artwork editor with all these important advantages:

- ☐ Complete interactive control over placement and routing
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- ☐ Single-sided and double-sided printed-circuit boards up to 10 x 16 inches
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- ☐ Can use optional Microsoft Mouse as pointing device



Twice scale hardcopy of your artwork is produced using the Epson dot-matrix printers or the Houston Instrument DMP-41 pen-and-ink plotter. Quick 1X check plot is also available from Epson printers.



Dual-layer color display of a 2" by 4" section of a 10" by 16" circuit board

The Smart Buy

At $895, smARTWORK™ is an exceptional value, particularly when compared to conventional engineering workstation costs.

Call or write us for more information on smARTWORK.™ We'll be glad to tell you how smARTWORK™ helps us design our own circuit boards and what it can do for your business.

Send a purchase order, or major credit card number, and smARTWORK™ can be working for you next week.

System Requirements

- ☐ IBM PC or XT with 192K RAM, 2 disk drives and DOS Version 2.0
- ☐ IBM Color/Graphics Adapter with RGB color or b&w monitor
- ☐ Epson MX-80/MX-100 or FX-80/FX-100 dot-matrix printer
- ☐ Houston Instrument DMP-41 pen-and-ink plot er (optional)
- ☐ Microsoft Mouse (optional)

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M·I·C·R·O·B·Y·T·E·S

Staff-written highlights of late developments in the microcomputer industry.

COMDEX: Morrow Unveils Battery Portable

At the recent COMDEX trade show in Atlanta, Morrow introduced the Pivot, a 9-pound IBM-compatible portable computer with a built-in one-third-height 5¼-inch disk drive and room for a second. The $2500 base configuration also includes a 16-line LCD, 128K bytes of RAM (expandable to 512K), a 300-bps modem, and batteries that last for 5 hours. The computer will not fit in a briefcase and stands upright rather than flat; the keyboard flips down. Morrow says it will offer a 25-line LCD early next year.

COMDEX: Laser and Color Printers Get Attention

Hewlett-Packard's $3500 LaserJet, based on Canon's 300-dot-per-inch LBP-CX laser printer, wasn't the only Canon at COMDEX. Quality Micro Systems showed a $9995 version that can print graphics by emulating Tektronix graphics drivers.

Earlier, Personal Computer Products Inc., San Diego, CA, announced a laser-printer controller for the Canon printer; a laser printer with the controller could retail for about $3500. Apple is also expected to announce a laser printer based on the Canon.

Several color-graphics printers were unveiled quietly at COMDEX. Seiko Instruments, Milpitas, CA, showed a $12,000 printer with a resolution of 152 dots per inch; Gulton Industries introduced a $4950 seven-color thermal-transfer printer with a resolution of 100 dots per inch.

Epson's JX-80, an $800 160-cps seven-color dot-matrix printer, can use either a four-color ribbon or a standard Epson FX-80 black ribbon. Dataproducts has two new color printers: a $1695 200-cps model and a 400-cps model for $2195. C. Itoh exhibited two seven-color dot-matrix printers, including a $2000 model with a 24-wire print head.

COMDEX: Makers Move to 3½-inch Drives

Citizen America Corp., a subsidiary of Citizen Watch, showed two 3½-inch floppy-disk drives that are only an inch high. Panasonic introduced both 3- and 3½-inch drives, including a 1¼-inch-high 3½-inch drive. Janome, which exhibited a 3-inch disk drive last fall, added a 3½-inch drive. Mitsubishi also showed a 3½-inch drive.

New Telecommunications Products for the IBM PC

ModTech International, Salt Lake City, UT, showed MasterLink at COMDEX, an $800 expansion board for the IBM PC. When you pick up the phone, ROM software automatically switches the computer from the current application to the on-board software. A $295 Night Owl option lets the system send and receive electronic mail unattended. Code-A-Phone, Portland, OR, showed the $700 Tel-A-Modem, a combination two-line telephone/modem allowing voice and data communications simultaneously. Both units include a 300/1200-bps modem. Three companies also unveiled internal 300/1200-bps modems for the IBM PC: Quadram's Quadmodem is priced at $595, Anderson Jacobson's PC Connection is $495, and U.S. Robotics' Personal Communicator is $499.

Demand Prompts Smaller, Higher-Capacity Hard Disks

Shugart and Cogito, which currently make 5- and 10-megabyte 5¼-inch half-height hard-disk drives, are both expected to introduce 20-megabyte versions at NCC. Mitsubishi showed a 20-megabyte 5¼-inch half-height drive at COMDEX, with a 1000-unit price of $875.

Microscience unveiled both a 10-megabyte half-height 3½-inch hard-disk drive *and* a 20-megabyte half-height 5¼-inch drive. The recently formed Lapine Technology announced 5- and 10-megabyte 3½-inch drives. Atasi, which now sells a 46-megabyte 5¼-inch hard-disk drive, exhibited a 75-megabyte version at COMDEX.

Dragon Industries, Hopkinton, MA, is selling 65- and 140-megabyte hard-disk systems for the IBM PC, priced at $4995 and $6995. Tallgrass Technologies added a $1995 60-megabyte tape drive that uses MS-DOS disk-access commands.

Dysan Corp. is now shipping Chocolate media to hard-disk manufacturers. Dysan says the product is a high-capacity alternative to the thin-film media now used in hard-disk drives.

(continued)

ACT Introduces New Apricot Computers

ACT was expected to introduce two new models of the 8086-based Apricot in late June. The Apricot Executive includes a 25-line LCD, a single 3½-inch disk drive, 512K bytes of RAM, a trackball/mouse, and a voice-recognition system for about $3000. The Apricot F1 is a $1600 system with 256K bytes of RAM and one 3½-inch disk drive. Both systems use an identical keyboard linked to the computer using either an infrared signal or a fiber-optic cable.

Two Firms Announce Speech Recognition for IBM PC

Microphonics Technology, Federal Way, WA, offers a $795 voice-recognition expansion board that can handle a 128-word vocabulary. Another speech-recognition system, the Speech Recognition Board from Interstate Voice Products of Orange, CA, will be introduced at NCC this month. The $1650 SRB will recognize up to 240 spoken commands. Either system can be used with off-the-shelf application programs on the IBM PC.

Digital Research Introduces Multiuser/Concurrent PC-DOS

Digital Research introduced StarLink, a $1695 expansion board for the IBM PC allowing you to link four terminals to the IBM PC using standard RS-232C cables. StarLink includes a version of Concurrent PC-DOS that allows the PC user to run up to four MS-DOS or CP/M-86 applications concurrently in addition to the program used on each terminal. Digital Research had originally planned an eight-terminal version of StarLink but delayed that product because of performance problems using the IBM's 8088 processor.

NANOBYTES

TTX Inc., Foster City, CA, has developed an interface/buffer allowing the Apple Macintosh to use a daisy-wheel printer. The TTX MACpac includes a 64K-byte print buffer and a 14-cps printer for $895. . . . **Digital Equipment's** LA100-PF is a $1595 240-cps dot-matrix printer that uses removable cartridges to select fonts and to emulate Epson or IBM printers. . . . **Harris** announced the 80C88, a CMOS version of Intel's 8088 processor. . . . **National Semiconductor** has renamed its 32-bit processors the Series 32000 and has licensed **Texas Instruments** as a second source for that line. . . . **The Neon Software Co. Inc.**, Middletown, CT, is selling IBM PC software on clothes hangers. Women's Ware includes Budgeting, Checkbook, Recipe, and other programs for $49.95 each. . . . **Diamond Computer Systems Inc.**, Santa Clara, CA, offers a $695 board that allows the IBM PC to run CP/M or Apple II software. . . . **Ericsson**, a European telecommunications and information systems firm, will introduce an IBM PC-compatible computer. . . . **WordTech Systems Inc.** introduced *dB*/Compiler, a $750 compiler for dBASE II. . . . **IBM** announced that it will sell enhanced versions of **Software Publishing Corporation's** popular PFS: series for $129 to $149. . . . Sheet feeder prices drop: **Multi-Matic**, Philadelphia, PA, is selling a $395 sheet feeder, which also uses a $50 adapter for attachment to a specific printer. **Brother** offers a $269 sheet feeder for its $995 HR-25 daisy-wheel printer. . . . **T.N.T. Software Inc.**, Round Lake, IL, is selling My Word!, a $25 WordStar-like word processor for the IBM PC. MBASIC source code is $25 extra. . . . **VisiCorp** has cut prices on all its products by about 50 percent and introduced FlashCalc, a $99 spreadsheet for the Apple II. . . . **Modula Computer Systems**, Provo, UT, now offers Modula-2 compilers for UNIX and for the Macintosh, priced at $94 and $150. . . . **Amlyn** has announced a half-height 3.2-megabyte floppy-disk drive that is not compatible with the Drivetec/Kodak 3.3-megabyte drive, while **Shugart Corp.** and **Phillips Peripherals** have both introduced 1.6-megabyte half-height 5¼-inch floppy-disk drives. . . . **Strobe Inc.**, Mountain View, CA, announced a $995 8-pen plotter. . . . Hong Kong manufacturer **Bondwell Industrial Co. Inc.** plans to buy **Spectravideo** and will add a $995 Z80-based portable computer with two single-sided disk drives and 128K bytes of RAM. . . . **Workman and Associates'** WRITE is *not* available for CP/M-86; this column reported in error that it was. . . . **Tallgrass, Information Storage Inc.**, and **CPT Corporation** are jointly developing an optical disk drive.



Now, translate your integrated software into integrated hard copy, with the TI OMNI 800™ Model 855 printer. So versatile, it combines letter-quality print, draft-quality print and graphics as no other printer can.

It prints letter-quality twice as fast as comparably priced daisy wheel printers, yet gives you characters just as sha p, just as clear.

It prints rough drafts ten times faster than daisy wheel printers . . . faster than most any other dot matrix printer.

Only the TI 855 has snap-in font modules. Just touch a button; change your typestyle. The 855 gives you more typestyles to choose from than ordinary dot matrix printers. It makes them quicker, cleaner, easier to access than any other dot matrix or daisy wheel printer.

The 855's pie charts are rounder . . . all its graphics are sharper than on other dot matrix printers, because the TI 855 prints more dots per inch. As for daisy wheel printers . . . *no* graphics.

The TI 855 Printer

The printer for all major PC's



For under $1,000 you get twice the performance of typical dot matrix printers. Or all the performance of a daisy wheel printer, and then some, for half the price.

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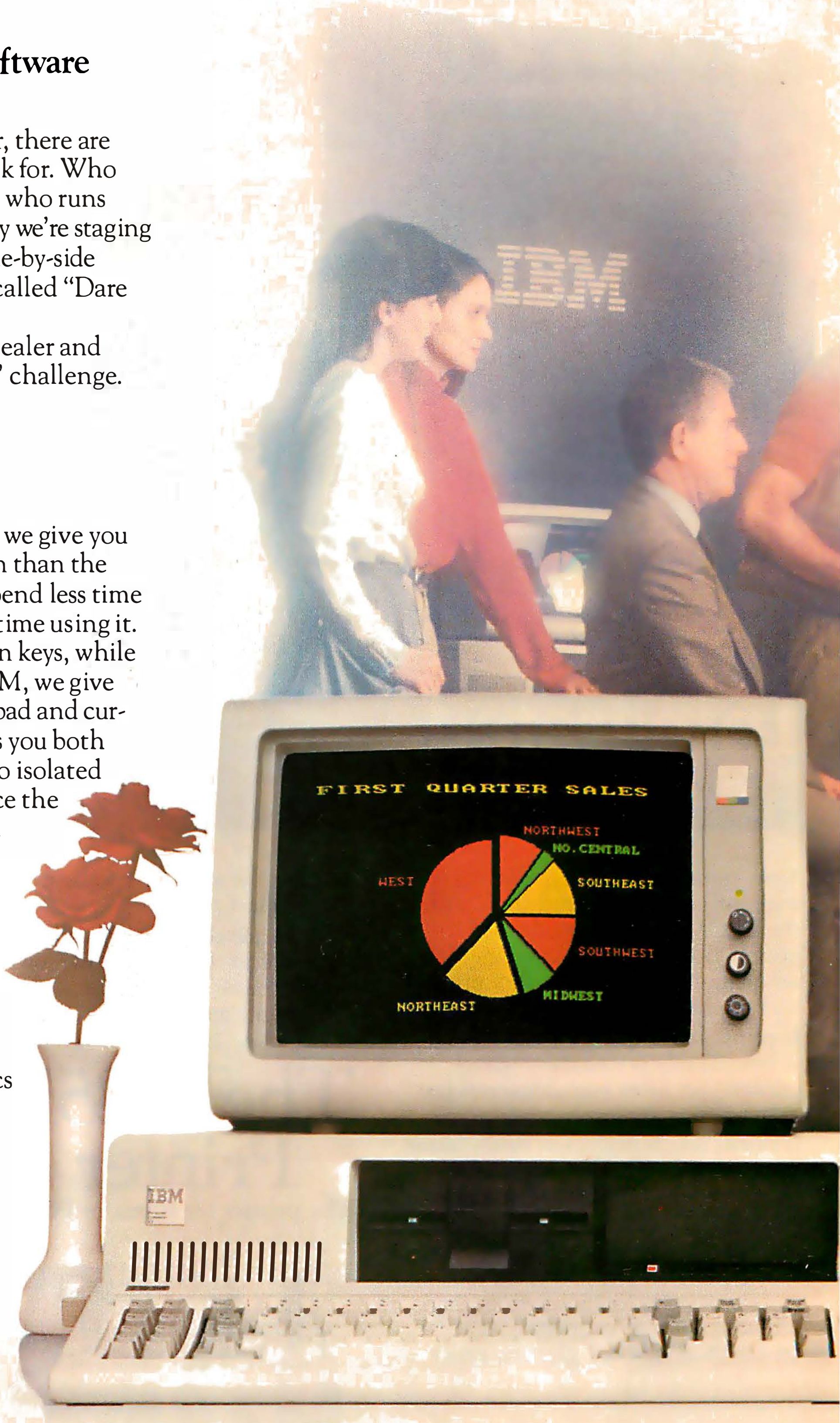
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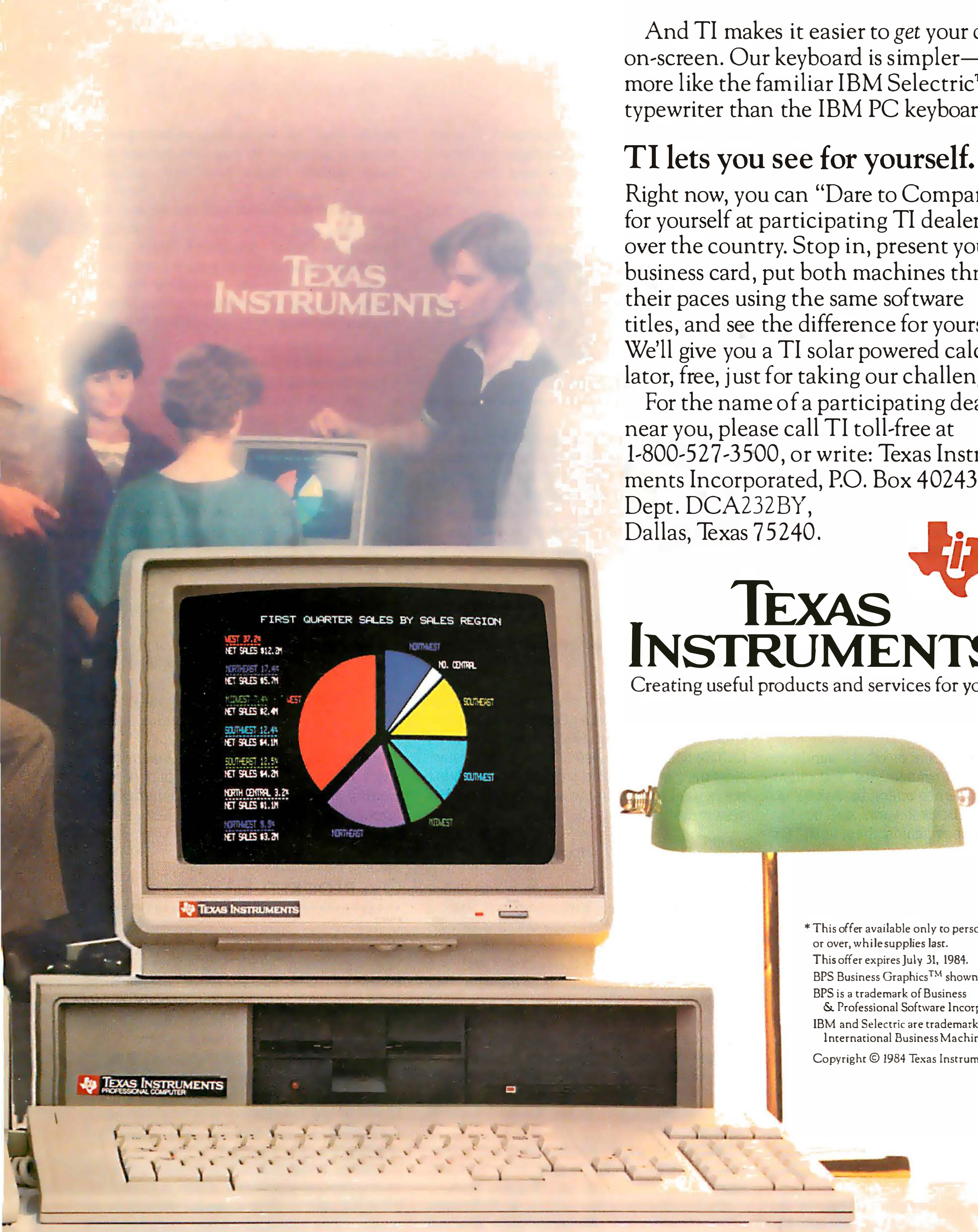
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BOUQUETS . . .

I applaud the April editorial "A Call for Ethical Standards for Personal Computer Magazines" by Phil Lemmons (page 4).

As president of the National Office Machine Dealers Association, I represent one of the distribution channels that markets small systems to end users. Our members/dealers pride themselves on their independence, objectivity, and the freedom to market whatever product we deem the best value for our customer.

By reinforcing your stand on objectivity, BYTE will continue to be the reference standard in our industry.

Keep up the good work!

JOHN KUCHTA
Lincoln, NB

As a professional journalist and regular reader of a wide array of technology magazines, I applaud your stance on ethical standards for computer magazines.

The guidelines you set forth in your April editorial are absolute essentials for any journalistic endeavor. I sincerely hope that your spirit of professionalism will spread throughout the computer magazine industry.

ERIK K. MEYER
THE MILWAUKEE JOURNAL
Milwaukee, WI

I enjoyed the April editorial on ethical standards for personal computer magazines. You ought to give article numbers to editorials, Ask BYTE, Chaos Manor Mail, Book Reviews, etc., so that readers can vote for or against them in BYTE's BOMB each month.

N.C. WEBB
Lincoln, MA

As a new subscriber to BYTE, I would like to commend you for your editorial in the April issue. Your objectivity in appraising both hardware and software is the prime reason I subscribe to BYTE.

CHARLES MATTSON
North Syracuse, NY

I like your magazine. The April editorial by Phil Lemmons was heartening for me in its description of your commitment to honesty of content. As a microcomputer user I am delighted to be able to look forward to reading a magazine with such high standards. Please keep up the good work.

WILLIAM Y. AGNEW JR.
Miami Beach, FL

After reading the replies to several letters in recent issues of BYTE, I am impressed. To a certain extent, the letter writers might be viewed as quibblers. But on the other hand, they raised some points that led the authors of some articles to add information to their subjects that otherwise might not have come out.

Letters are one of the features I always read and they are especially educational when there are replies like yours.

WAYNE L. ST. JOHN
Carbondale, IL

. . . AND BRICKBATS

As a software author, I object to your aiding and abetting the violation of copyright laws by posting notices by people requesting software exchanges in your Unclassified Ads section. Such ads in essence read: "Send me copies of your programs, and I will send you copies of mine." I cannot believe that I am alone in my objection.

SCHUYLER M. MOORE
Los Angeles, CA

Please see the new advisory on Unclassified Ads.

Aw c'mon; your April cover would have us believe that God used a portable computer to create the world. What do you take your readers for? He would have used at least a mainframe. Next thing you'll try and tell us is that He didn't really want to rest on the seventh day but His system was down so He had to!

ROY SMART
Hopewell Junction, NY

In last December's issue I expected to find a Cumulative Index as I had in previous years. I was disappointed when I saw that this service apparently had been discontinued. The index has particular value for the hobbyist and as a regular subscriber I recommend its continuance.

One more gripe: Despite the enthusiastic acceptance of the IBM PC there is still a large number of Apple computers in the hands of your readership and more are being sold every day. Could you please consider this and give us Apple owners a more evenhanded share of your attention?

Despite this regrettable tunnel vision, I think your magazine is still the most enjoyable and readable around. Keep up the good work.

R. P. STUBBS
Kaweraw, New Zealand

We apologize for the lack of a cumulative index for 1983. We are working on a comprehensive new approach to make the indexes much more usable. Please bear with us. As to coverage of Apple products, we have previewed the Macintosh and the IIc and have published such recent articles as Apple FAX, Macintosh Pascal, Macintosh BASIC, and a two-part data-acquisition system based on the Apple II. We also are publishing the BYTE Guide to Apple PCs *in October. The* Guide *will be provided to all BYTE subscribers at no cost.*

Few things in life bother me enough that I write a letter to the editor of a magazine. Unfortunately, I now must take word processor in hand and pen a letter of complaint about your fine publication. I have no complaint with the magazine itself or its editorial content; in fact, it is the only magazine I read cover to cover monthly.

My problem is with the circulation department. It drives me nuts to see the new issue of BYTE in the bookstores and on the magazine racks of local computer stores two weeks before I receive mine in the mail. A day or two I could live with, but not two weeks. I would like an explanation of this discrepancy.

It's no fun having my friends ask me if I've read an article in BYTE and having to tell them I still haven't gotten mine yet.

ROBERT FRUIT
No return address

The circulation department has taken several steps to speed delivery to subscribers, including arranging for drop shipments to different regions of the country. Let us know whether things improve.

OVERLOOKED BASICs

Your features on BASIC in the April issue were very interesting, and I would like to add a couple of comments. HP BASIC, probably the most powerful BASIC for any microcomputer (especially as implemented on the Series 200 machines) was conspicuously absent. This BASIC is the only one that has found wide acceptance as a useful tool in the engineering community because of its powerful command structure and exceptional graphics commands that allow simple plotting and labeling of engineering-type displays.

Another BASIC that is often overlooked is that of the Sinclair machines, which is one of the most logical and clear of BASIC dialects. In addition, it has a twist to the VAL command that I have seen on no other machine. VAL does not

(continued)

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just return the numeric equivalent of a string but rather evaluates any legitimate BASIC expression in the argument and returns its value, so that

```
PRINT VAL (SIN(PI/4))
```

returns .70710 rather than 0 or an error. This makes entry of formulas into a program simple, because you can use

```
INPUT N$
sin ((x^2)/tan(y))
PRINT VAL N$
```

which will return the correct answer if x and y are defined.

In the discussions of "structured" versus "unstructured" programming, the GOTO statement is universally censured. Far worse than a GOTO is the universal use of obscure PEEK and POKE statements required by most microcomputer BASIC dialects to accomplish simple tasks.

Thanks for an interesting issue.

V.P. O'NEIL II
Gilbert, AZ

Your April review of new BASICs was of great interest since I have used BASIC for years in a small business.

In 1979 I obtained a North Star Horizon and, using North Star BASIC, implemented a complete package including editor, general accounting, mailing list, etc. I am told that our system is archaic, since it uses a poor language and runs on an 8-bit processor (Z80) with a 4-MHz clock.

For a different business, I recently obtained a Hewlett-Packard Model 150 with an 8-MHz clock, 8086 processor, and Microsoft BASIC.

I ran the following program on both machines. (The DEFINT statement, absent in North Star BASIC, tells the HP 150 to force "I" to a 16-bit integer, saving time in the FOR loop.)

```
10 DEFINT I
20 A = 0
30 FOR I=1 TO 20000
40 A = A + .00001
50 NEXT
60 PRINT A
```

The North Star computer did the loop in 65 seconds, yielding the right answer, 0.2. Microsoft BASIC took 50 seconds (a savings, but not much), yielding the wrong answer, 0.1999783.

So, a better BASIC will be welcome as a "standard." Meanwhile, we have purchased a used North Star as a backup to run our old, obsolete, and dependable software.

PAUL T. BRADY
Middletown, NJ

I enjoyed reading the series of articles on improved versions of BASIC in the April issue. However, I was surprised that no mention was made of the extended BASIC that has been available on Hewlett-Packard's "scientific" series of computers for nearly a decade. For example, the HP-86 computer has roughly 170 functions and commands available, with plug-in ROMs available for file management, matrix manipulations, interface control, listing of variable cross-references and program flow, etc., for a total of about 330 functions. From the articles in the April issue, it appears that other companies have almost caught up with HP BASIC in a few areas and surpassed it in only one case (Macintosh BASIC). More recent HP computers are significantly improved over the 86. The 9816 ("200/16") offers every structure you could want for control of program flow but lacks the structured variables of Pascal and other newer languages. Although its variables are limited to arrays, the 200/16 can sort a string array with a single command. HP also has integrated a spreadsheet with the BASIC language on the 75 computer. Users can create their own VisiCalc functions as well as incorporate spreadsheet abilities into BASIC programs.

Some enhancements can only be implemented by a computer manufacturer. For example, the HP-86 has seven dedicated keys to control program debugging and execution (besides the 14 programmable function keys), optional ROMs that make additional functions always available (even without a disk drive), and perhaps most importantly, an operating environment that supports the BASIC language. For example, users can execute several commands in immediate mode from the display screen then edit in line numbers to quickly develop programs. What is unfortunate about these computers is that little applications software is available, and the user is thus forced to continually write programs when a database system or integrated package could provide even quicker results.

Your readers may also be interested in a speed comparison of some BASIC implementations. Execution speeds for a simple division program to calculate prime numbers (*Interface Age*, August 1981) are: Apple II, 970 seconds; IBM PC (Microsoft BASIC), 785 seconds; HP-86, 1425 seconds; HP 200/16, 82 seconds; Apple Macintosh (Microsoft BASIC), 784 seconds. The Macintosh and HP machines used variables with about twice the numeric precision of the others. It is interesting to note that the Macintosh is no faster than the IBM PC. This is not merely a case of differences in precision because the HP 200/16 with the same processor as the Macintosh and higher precision is about 10 times faster. Perhaps the Microsoft implementation is particularly sluggish. It would be interesting to evaluate Apple's Macintosh BASIC.

RANDY WEBB
Bloomington, IN

Your April articles on improved BASICs were very informative, even inspiring. It's about time BASIC grew up. As an educator, I have had mixed feelings about teaching BASIC as a first programming language. BASIC is easy to learn, but a lot of bad habits have to be unlearned later. Some college instructors have gone so far as to say they prefer incoming students who have *no* programming experience to those who have learned BASIC. The "experienced" BASIC programmers are famous for their tangled, poorly planned "spaghetti programs."

Now the situation should change. But here's

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the catch: After talking with the people at True BASIC Inc. and at Software Technology (authors of BetterBASIC), I have learned that these languages are *not* being planned for adaptation to the Apple II. And let's face it, the vast plurality of public schools use the Apple II. Are we to go on teaching bad habits to our beginning programmers? Pascal is certainly an alternative. But Pascal is intimidating and hard for many students to learn as their first language. Editing, compiling, executing, and re-editing to debug a program can severely test the patience of a young person.

Supposedly, the 6502 and Z80 processors are not "powerful" enough to handle the wonderful new BASICs. But even a low-end machine such as the Commodore 64 has a good choice of structured, "user-friendly" languages. Simon's BASIC allows many of the features of Pascal. And a relatively unknown language, COMAL, has been around for years on Commodore machines. COMAL is incrementally compiled and allows procedures and functions with global and local variables. It permits nested IF/THEN/ELSE statements and a wide variety of looping structures (REPEAT/UNTIL, WHILE/ENDWHILE, and LOOP/EXIT/ENDLOOP). The Commodore 64 version also supports high-resolution turtle-graphics commands and is available *free* in the public domain! It does not have fancy features such as "windows," but this is a luxury better suited for 16-bit processors that can address more memory.

It is indeed ironic that the Apple II, the most widely used and generally best-supported computer in our public schools, does not have a good language available for teaching beginning students. The best I've been able to come up with is Microsoft's GBASIC (running under CP/M), which has the WHILE/WEND loop but not much else in the way of structure. Digital's CBASIC looks fairly good at first glance but does not allow nesting of IF/THEN/ELSE statements, which mandates use of a lot of GOTOs. There is one place in Denmark that may offer a nongraphics CP/M version of COMAL for the Apple II. But have you ever tried to get a school district to approve a purchase order to Denmark?

High school computer education is now facing a terrible dilemma. What do we teach? Isn't it about time *somebody* offered a well-structured, incrementally compiled language for the Apple II?

WENDELL BROWN
Kent, WA

CSS LANGUAGES

"ISIM: A Continuous-System Simulation Language" by Roy E. Crosbie (May, page 400) was interesting. I think you could have helped your readers by adding a box informing them that several other CSS languages were listed in "Going Further" by Charles Pratt (March, page 204).

GERALD L. GOTTLIEB, PH.D.
Evanston, IL

(continued)

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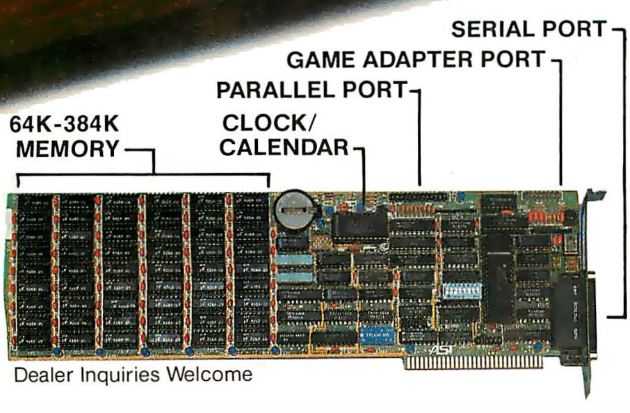
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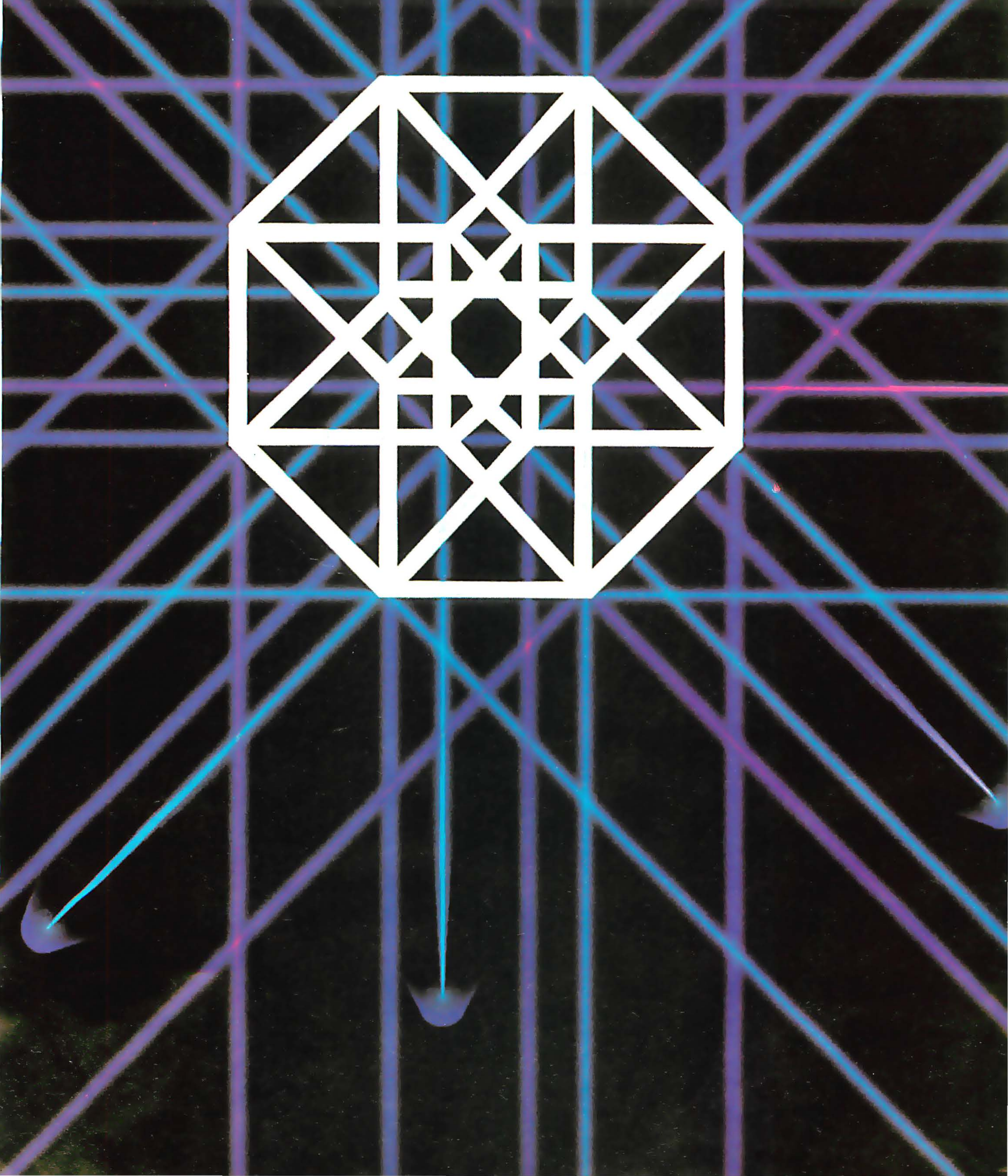
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To Err Is Indeed Human

Greg Scragg's "criticism" (April Letters, page 20) of Douglas Davidson's "forgotten" sort ("Address Calculation: The Forgotten Sort," November 1983, page 494) demonstrates too much enthusiasm and too little familiarity with the subject area. He quotes Donald E. Knuth (*The Art of Computer Programming*) as proving that "no sort can work in time less than O(n log n)." What Knuth clearly points out, but Mr. Scragg appears to have missed, is that this bound only holds for "sorting techniques which are based solely on an abstract linear ordering relation between keys" (Knuth, volume 3, 1st edition, page 181)—specifically excluding such methods as address calculation. In fact, Knuth describes the address calculation sort, concluding that "we have achieved a sorting method of order N, provided only that the keys are reasonably well spread out over their range" (Ibid, page 102)—precisely the claim Mr. Davidson makes.

Mr. Davidson's article presents a simple, too often neglected algorithm with which many of BYTE's readers were likely unfamiliar. Mr. Scragg's letter is unjustified and inept, and seems unforgivable regardless of the state of his schooling.

Mike Dixon
Ontario, Canada

This letter is representative of several we received regarding Mr. Scragg's criticism of Mr. Davidson's article.

Iconolatry

To complete Gary Sanford's amusing "ultimate allegory" (April Letters, page 15), I suggest a passenger-driven mouse—nothing elaborate to begin with, say, 50cc with a 4-speed box (labeled N, S, E, and W). The posher PC pushers would soon rush in with add-ons: seat belts, "I ♥ my ..." stickers, in-dash computers with submice.... There is (literally) no end to the possibilities.

Another aspect of Tom Houston's iconolatry ("The Allegory of Software," December 1983, page 210) puzzles me. I've often wondered why the drudgery of program development has not been enlivened by the use of video-game graphics. I have in mind, for example, that instead of typing ERASE FILENAME it would be more fun to have all your FILENAMEs floating around the screen in little boxes while you try to blast the right one with your joystick button. Much less user-mollycoddling than having mousey drag off naughty Freddy File to the trash can.

Stan Kelly-Bootle
Mill Valley, CA

Design Flaws

Some of the examples and assertions of Mark Johnson and Allen Munro's "Pascal's Design Flaws: Modula-2 Solutions and Pascal Patches" (March, page 371) are misleading or incorrect with respect to the Pascal language as defined by the International Standardization Organization (ISO Pascal). Standard Pascal:

1. does not have a built-in string type
2. allows short-circuited evaluation of Boolean expressions (implementation-dependent)
3. includes, at level 1 of the standard, "open" array parameters (referred to as "conformant array parameters" in the standard)
4. defines an out-of-range case selector to be an error

Steve Brecher
Software Supply
Long Beach, CA

We thank Steve Brecher and others who have pointed out some of the ways that standard versions of the Pascal language (as developed by the ISO and the American National Standards Institute) address the Pascal design flaws we discussed.

One of the problems with talking about Pascal is making it clear which "standard" Pascal you are talking about. Our article pertained to the original definition of Pascal, as published in the Pascal User Manual *and* Report *by Kathleen Jensen and Niklaus Wirth. We chose to discuss Pascal's problems in terms of* UCSD Pascal *because it is the most widely used implementation for microcomputers. Future Pascal implementations will undoubtedly be influenced by newer standards from the ISO and ANSI. Thus far, however, the user base for UCSD Pascal far exceeds that of other implementations.*

Mark Johnson and Allen Munro
Redondo Beach, CA

The Spirit of Benchmarks

I enjoyed reading "STSC APL* Plus and IBM PC APL: Two APLs for the IBM PC" by Jacques Bensimon (March, page 246). Although STSC's APL*PLUS/PC is a very fine product, the soon-to-be-released I.P. SHARP APL/PC promises to contain the powerful operators, such as nested arrays, that most sophisticated APLers expect from their language. I hope BYTE will have the opportunity to review I.P. Sharp's upcoming product.

In response to page 250 of the article, Mr. Bensimon remarks "... a significantly modified algorithm to reduce execution time, which goes against the spirit of benchmarking" was used in an APL solution submitted by Michael Rowe and Donald Stoneburner (May 1983 Letters, page 8). As the Rowe half of the Rowe and Stoneburner solution, and as a professional who has been involved with many benchmarks of commercial systems, I cannot comment on what is the "spirit" of benchmarking, nor am I sure that benchmarks even have "spirits." What I would like to assure the fine readers of BYTE is that there is a purpose for doing benchmarks.

ILLUSTRATED BY JEREMY VARNUM

A benchmark's purpose is that of evaluating and quantifying the efficacy of hardware/software environments within a relevant range of use. A relevant range would be defined by the particular purpose of a benchmark. If a benchmark is performed to generate capacity planning decision information, the relevant range would be based on anticipated utilization; or if a benchmark is performed for systems tuning or performance analysis, the relevant range is based on present utilization. You can always make a benchmark look extremely bad or extremely good for a particular software/hardware environment, but a well-designed benchmark will strive to make representative use of the hardware/software environment by selecting commonly accepted and practiced programming techniques. Most professionals soon find and adopt efficient programming techniques and algorithms (count the times that you or a colleague has made the remark, "I have this routine running twice as fast and with half the code"). Thus, most benchmark designers take for granted that the average programmer is no dummy and therefore tests efficient and representative algorithms. The Rowe and Stoneburner solution is efficient (22 milliseconds for 10 iterations running on an IBM 3081) and makes use of commonly utilized APL programming techniques.

As for the "significantly modified" nature of our algorithm, I thank Mr. Bensimon for his opinion, but I do not concur. Conceptually, each alley of the Sieve of Eratosthenes can be thought of as a Boolean decision processor, in that a ball rolls down an alley (representing a particular number) *and if* it encounters a hole (representing the number's factorability by a previously derived prime) it is proven *not* to be prime. Our algorithm is true to this original construct, in that we generate a bit mask based on previously derived primes and perform a Boolean AND between this mask (representing the sieve holes) and a bit string (representing all possible numbers (alleys of the sieve)).

One additional note concerns bit-string implementations. PC versions of APL (and some other languages) do not universally implement true Boolean strings, in that a whole byte or integer is sometimes used per single bit. If this were the case, an algorithm that is highly dependent on Boolean operations may have highly variable results in relation to memory utilization and execution speed across software implementations. I have heard, but cannot confirm, that the first release of STSC's APL*PLUS did not have true bit strings, but that the current release does have true bit strings.

MICHAEL C. ROWE, PH.D.
Lewisville, TX

SIMULATION LANGUAGES

I was very interested in the theme articles on simulation in the March issue, but rather disappointed by the sparse and vague references made to European, and especially British, developments in this field. This is surprising and unfortunate because considerable attention has been paid in the United Kingdom to the use of existing (mainframe) simulation languages on microcomputers. This approach has two main advantages: the microcomputer-based system can be used without retraining personnel who are already familiar with the language; and a mainframe can be used if the model becomes too large for the microcomputer.

The languages that I refer to are the Extended Control and Simulation Language (ECSL), together with its associated code generator CAPS; SEE-WHY; and FORSSIGHT, the current version of the original general-purpose simulation language, GSP (General Simulation Program), which was first used in 1958. All of these languages also support dynamic graphic display facilities on microcomputer systems. As far as I know, FORSSIGHT is not yet available in the United States, but ECSL and SEE-WHY are both actively marketed here.

These three languages use the powerful three-phase activity cycle representation, sometimes called the "British" approach. This means that they can be used only for pure discrete event modeling purposes. This approach has the benefits of being easy to understand and code, and it eases certain modeling decisions.

I hope that this letter will draw your readers' attention to these languages, so that they will consider them when choosing a simulation language.

ROBERT I. MILLS
West Lafayette, IN

A MINOR PROBLEM

For someone who "writes extensively about computers," Ed Teja seems intent on coming across as a novice ("Compupro's System 816/C and System 68K—the Two and Only," March, page 214). His persistence in referring to the "68K bytes" of CompuPro's 68000 board is in strange contrast to the technical detail of the rest of the article. How could he possibly miss "68K" being an abbreviation for "68000"? And how can I possibly take seriously someone who makes such a flub?

PAUL ROBINSON
Framingham, MA

There was no "persistence in referring to the '68K bytes' of CompuPro's 68000 board." In one caption an editing change converted the declaration that this was a picture of the System 68K's central processing unit into the misstatement Mr. Robinson noted. I should have caught the error in the galleys. I didn't. Mea culpa.

EDWARD TEJA
Santa Cruz, CA

COMPARING COMPILERS

I found Kaare Christian's "Inside a Computer: Notes on Optimization and Code Generation" (February, page 349) most intriguing, and I

(continued)

rushed to my IBM PC to see what kind of optimized code Microsoft's 3.13 Pascal compiler produces for the Sieve of Eratosthenes algorithm. [For more information see "Eratosthenes Revisited: Once More through the Sieve" by Jim Gilbreath and Gary Gilbreath, January 1983, page 283.] Eagerly comparing my .COD listing to the DRI and Intel listings, I saw a close correlation between Microsoft's and Intel's optimization strategies.

My summary: Where Intel dedicates CS and AX to somewhat specific functions, Microsoft seems to use AX generally. This results in five instructions (that the Intel code did not require) to load AX with the desired values. In one case, Microsoft saves an instruction adding directly to the count in memory, whereas Intel adds to and then stores AX. The bottom line is that Intel produces a tighter, faster Sieve, but not by much.

Because I use MS-DOS and do not have access to iRMX/86, I was pleased to see how well Microsoft Pascal optimizes. Although some may be bothered by the fact that the Microsoft .COD file is just a memo listing and not an assembly-language source that can be modified, this suits me just fine. Code that is not tinkered with is one less picket in the fence to come loose—or one less to be hammered up in the first place. The fact that the compiler does such a good job of optimizing is key to my happiness.

As Christian points out, the use of .COD lists is most helpful in analyzing alternative coding tactics. In one case, a piece of my Pascal source code looked redundant because a variable expression was explicitly stated in two consecutive lines. When I compiled this alongside an alternative that precomputed the expression, I discovered that the compiler carried the results of the expression evaluation to the second line, doing automatically, and in less code, what I attempted to achieve in my alternative.

As a final note, Christian's discussion of ways to beat the FOR loop control was most instructive. Microsoft, by the way, exhibits the same weakness that Intel does.

CHET FLOYD
Manhattan Beach, CA

STILL MORE ON THE MAC

After reading the February issue on the Macintosh, I flipped through some old copies of *Scientific American*. An article in the June 1978 issue caught my eye: "The Earliest Precursor of Writing," in which Denise Schmandt-Besserat investigates pictographic versus ideographic origins of writing. It suddenly struck me that the Lisa and Macintosh represent a major step backward in the state of the art of recordkeeping, on the order of perhaps six millennia. Congratulations Apple! The computer, originally conceived of as a tool to expand the horizons of man's intelligence, is instead now encroaching upon it.

THOMAS LITANT
Tokyo, Japan

There is an important difference between Macintosh's graphical images and those of prehistoric man. Mac's icons provide a method of controlling an interactive device, while prehistoric man's were for recording information.

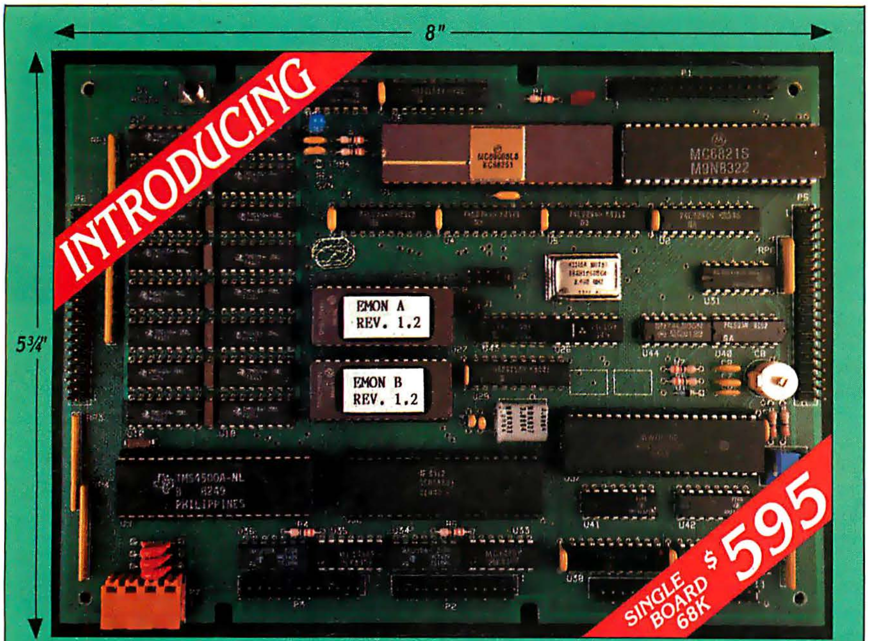
THANK YOU

Several months ago I wrote to you asking if any of your readers would be interested in contributing programs to a book called *Microcomputer Programs in Medicine*.

The response from your readers was astounding. I received letters, postcards, packages of disks, and printouts from all over America, various parts of Canada, England, Ireland, South Africa, Saudi Arabia, Israel, Australia, Malaysia, and even one from mainland China.

I received phone calls in the middle of the night from people asking for details of the im-

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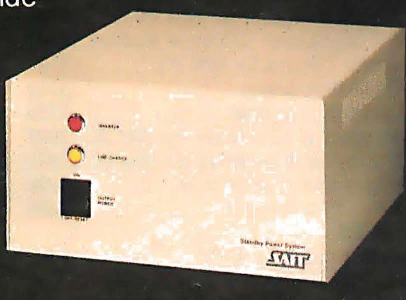


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The book is available from Computer Medica Corporation, Medical Software Company, 328 Main St., Center Moriches, NY 11934.

I must thank your readers again for the fantastic response.

Derek Enlander, M.D.
New York, NY

The Perfect Microcomputer

First, let me congratulate you for having the finest computer magazine and the finest consulting editors: Steve Ciarcia and Jerry Pournelle. I agree with their assessment of the industry as exemplified in the May issue.

I find the prevalent state of the microcomputer industry appalling. Although we have had two very powerful 16-bit processors available from the start of this decade (the MC68000 and the Z8000), they are not in most microcomputers and are underutilized in all but the most expensive. Mr. Ciarcia's Trump Card, for example, is a great addition to a PC, but why is it necessary? Did Intel and IBM conspire to offer America inferior technology? And why is the Z8000 such an underused chip?

Having owned three personal computers, I am ready to buy again, but this time I have some specific criteria in mind. I would like a 16-bit processor, at least 512K bytes of RAM expandable to at least 2 megabytes, two disk drives of at least 512K bytes each, multiuser capability, a good operating system with plenty of software, and an under-$3000 price tag.

Guess what? There are none. Two computers that come close are the Sage and the Pinnacle. The Sage is a little too expensive at present, and the Pinnacle needs software. But why are there no Z8000 machines? I believe there are many computer sophisticates such as myself who would buy such a machine.

Richard H. Knop
Kansas City, MO

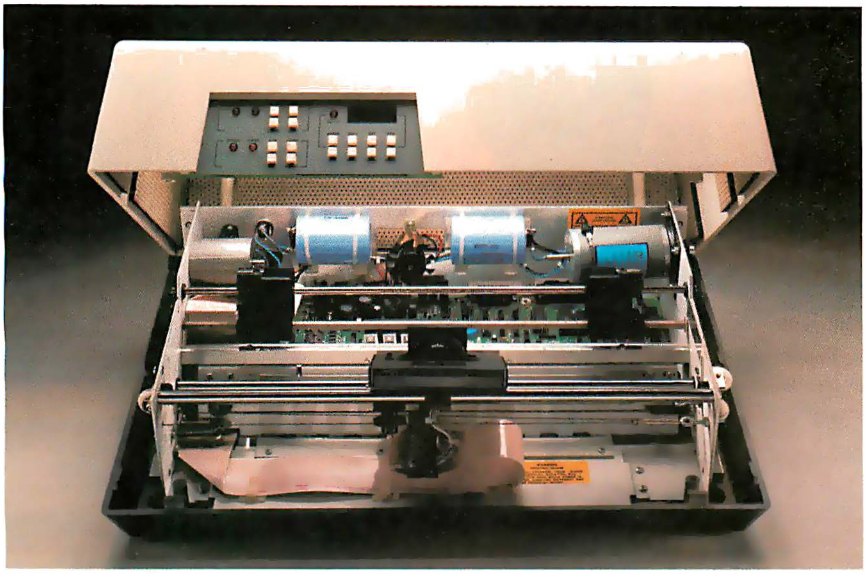
Mumps

I read with interest Jonathan Javitt's article "Computerizing a Medical Office" (May, page 171). I have been involved in this field from both a programming and a medical perspective for over five years. I am in particular agreement with the seven-step approach Dr. Javitt recommends for effective use of computers within a

(continued)

HIGH PERFORMANCE

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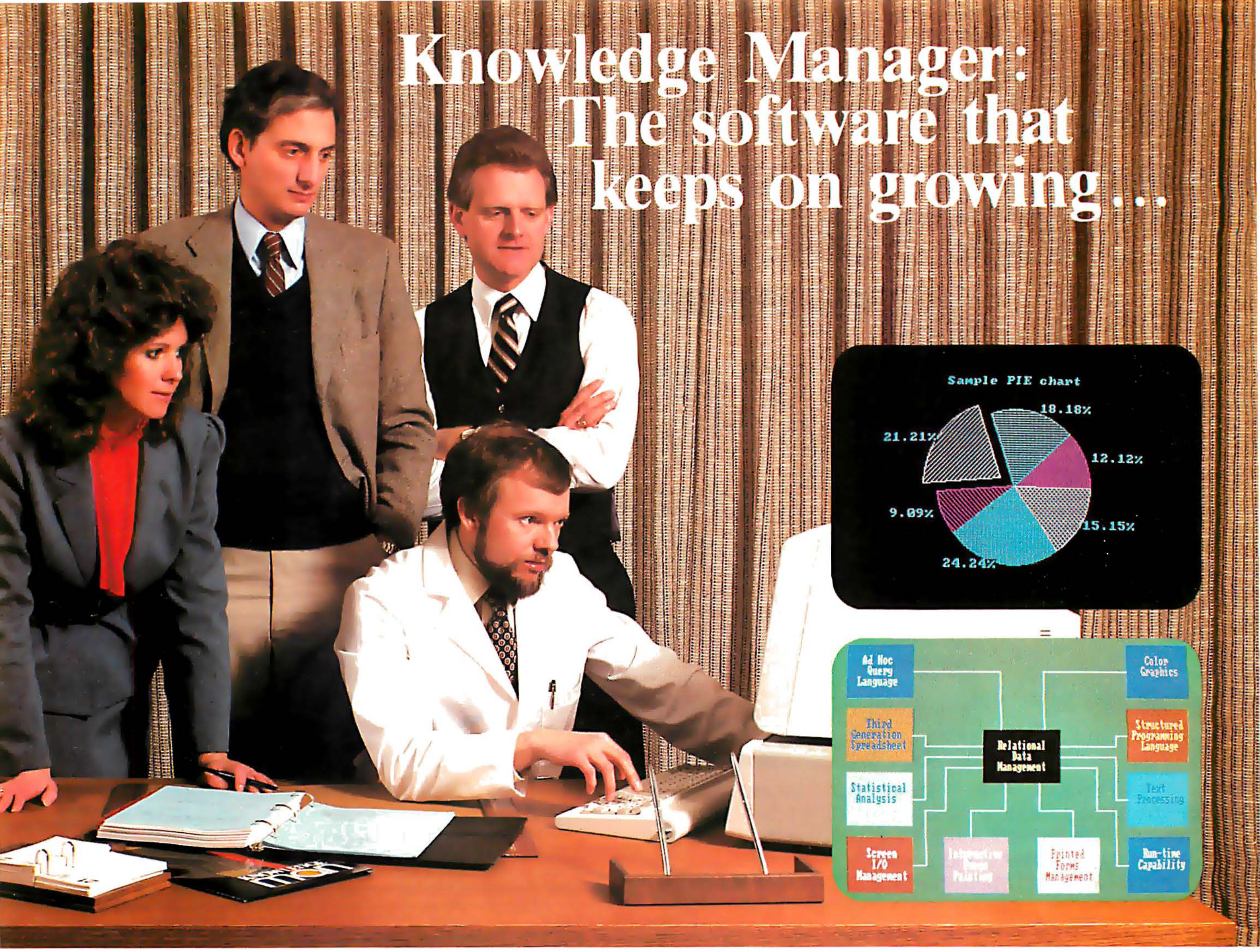
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medical practice.

However, as both a software vendor and a physician I disagree with some aspects of the article. On page 174, Dr. Javitt says:

> *. . . packages have been created that accommodate specific items of clinical information. These programs allow a practice to designate 10 or 20 items that must be recorded for each patient and to configure data fields to store those items. . . . What is needed is a relational database that is able to track clinical parameters over time and correlate them. . . . This level of sophistication has not been developed under current microcomputer systems and is currently available only under Unix.*

Our medical-software package now supports both free-text entry of patient records and storage of up to 1000 problems per patient. All information is retrievable individually or in groups selected from criteria of the practice without resort to custom programming with up to fifty Boolean AND, OR, and NOT operands for either inclusion, exclusion, or both.

On page 176 Dr. Javitt states:

> *Installation . . . is time-consuming. . . . In the initial phase, the personal data on each physician in the practice must be entered as well as the particulars of each insurance carrier with which the practice deals. A complete list of diagnoses and procedures used in charges and . . . codes. . . . Try to find a program that can learn new diagnostic codes and procedures as it comes across them.*

Our software package "learns" all data about a practice as required during a normal posting cycle. Thus, patient data, diagnostic codes, procedural codes, insurance carriers and codes, and provider information are all entered only when outside the current boundary of the known practice data.

The trick is not alchemy but rather Mumps. This ANSI-standard language/operating system/filing system supports a remarkably flexible data structure almost handcrafted to the needs of medical users with both variable-length records and multiple linked records per patient possible. Argument indirection permits the user to enter a variable whose truth value can be tested easily across the entire database. Finding all patients who are 35-55 and have hypertension and diabetes, for example, is easy. Finally, Mumps is available for microcomputers and minicomputers, ranging from the Apple II and clones to the largest networked mainframes, all without alteration of source code.

Both as a programmer and a physician, I have found the Mumps language to be a joy; I am only sorry that BYTE has not represented this computing option to its otherwise well-informed readership.

DOUGLAS H. MCNEIL, M.D.
Little Rock, AR

YOU THINK YOU'VE GOT PROBLEMS

Our corporation consists of two divisions. One is an offshore drilling and training division. The other develops computerized operating programs for the petroleum industry. We who work in the offshore drilling and training division are constantly exposed to terms and definitions from the computer division that we do not understand, such as gigabyte and multibus. And when we ask the computer division questions about what they are talking about they look at us like we are idiots. So we took it upon ourselves to find out what these terms mean, and due to our diligence and constant searching we did locate a multibus, of which we have enclosed a picture (see photo below). We would appreciate it if you could print it in your magazine so that all the other people who are constantly exposed to these computer people and who have no idea what they are talking about will at least know what a multibus is.

We are still searching for a gigabyte and are somewhat apprehensive about looking for a terabyte. If anybody else out there needs our assistance please feel free to write us and we will see if we can find what they are looking for.

GENERAL PETRO SCIENCE
Houston, TX

ARE YOU SITTING DOWN?

While I'm still in shock, I thought my fellow readers should be informed about the cost of computer repairs. I purchased a Columbia VP portable in September (by mail order) with the belief that nationwide servicing through Bell & Howell would negate any problem of not buying from a local dealer. (As a research engineer, I didn't need any dealer support for my applications.) Was I ever wrong!

When my machine went down on December 30, I figured a quick trip to Bell & Howell would take care of it. After all, it was probably just the Motorola 6845 CRT controller chip that needed replacing. It took a little longer than expected because, despite national advertising, Colum-

(continued)



bia Data Products Inc. did not have a servicing agreement in effect with Bell & Howell for the VP until January 1, 1984. In all fairness, the people I dealt with did their best to get my machine fixed—they just didn't have any idea how much it would cost. It came to $811.06.

Why? It's simple. Servicing consists of replacing the motherboard at $630 plus tax, plus two hours of labor at $64 per hour. While this may be an acceptable way of performing service for a business, the individual consumer simply can't afford it. It is equivalent to replacing the engine whenever your car won't start. How many of us would own cars under that condition? Therefore, I have some suggestions for the individual owner: (1) Find a reputable serviceman who will fix what's wrong with your machine (not just replace boards) *before* you buy it. Buy only what you know can be serviced reasonably. Many users groups know of such people and could put you in contact with them. (2) If you know nothing about computers or electronics and can't find a suitable serviceman, then buy a service contract from your dealer or a reputable service organization.

As for me, I'm going to buy one of every chip on the motherboard (which will cost less than a service contract) and fix it myself the next time it fails.

MICHAEL W. FITZPATRICK
Westerlo, NY

THE ORIGIN OF "BUGS"

Several recent magazine articles and a book (*The Naked Computer*) have suggested that the words "bug" and "debug," used in relation to computers and computer programs, originated because a moth flew into the relays of the Mark I at Harvard.

Though this incident undoubtedly occurred, the meaning of the word bug is at least a hundred years older. For example, here is an excerpt from a letter written by Thomas Alva Edison to Theodore Puskas, Edison's representative in France, on November 13, 1878:

> I have the right principle and am on the right track, but time, hard work, and some good luck are necessary too. It has been just so in all of my inventions. The first step is an intuition, and comes with a burst, then difficulties arise—this thing gives out and then that—"Bugs"—as such little faults and difficulties are called—show themselves and months of intense watching, study and labor are requisite before commercial success—or failure—is certainly reached.

JOHN LORD
Santa Monica, CA

IN PRAISE OF THE MAC

As an engineer, I have been using mainframe computer and minicomputers for the last 25 years. I have always viewed the microcomputer industry as being characterized largely by trash software running on trash hardware. For the past few years there has been frantic activity but little forward progress. For this reason, I find it sad to read all the letters nitpicking the Apple Macintosh. Perhaps these writers are proud of their ability to remember that <cntl><alt>Q moves the cursor left two characters (or was it three characters?) and are intimidated by the thought that soon anyone will be able to use a computer. In developing the Macintosh, Apple has done something unique in the microcomputer field—combined excellent hardware with excellent software. I think that Apple's pursuit of excellence is far more important to the future of microcomputing than the temporary difference between 128K bytes and 512K bytes of memory. This letter was, of course, composed on my new Mac. For the first time in 25 years, I am having fun using a computer.

GEORGE ROOT
Boulder, CO ■

READ  ONLY

A review of the IBM Personal Computer family. Summer 1984



UP AND RUNNING

And Swimming, Building, and Baking. Building and baking? They don't produce gold medal winners, but they do figure in staging the Olympic games. So do 200 IBM Personal Computers (including software) that are part of IBM's sponsorship of the 1984 Olympics in Los Angeles. In fact, IBM PCs are hard at work in both sports and administration.

PCs are involved in a wide range of planning and analytical activities, though they don't provide official results of the various athletic events. Some events, for example, use the IBM PC to determine how competitors are seeded—who competes against whom. In other events, such as archery, the PC simplifies the complex task of recording scores and compiling statistics for each athlete as the competition progresses.

In events like gymnastics that depend on points awarded by judges, statistics can be kept on the PCs to analyze scoring consistency. Also, a whole range of information about individual athletes, past Olympics, and world and national records, both past and present, can be quickly recalled and compared with the help of the IBM PC.

Last but not least, administration. Spreadsheet programs, such as IBM's Multiplan™, were used on the PC for planning and forecasting by nearly every administrative department, from Construction to Ticketing. The same departments speed up some of their day-to-day accounting tasks with the help of the PC and IBM accounting packages.

Departments with specific software needs developed special packages with the assistance of a programmer whose services are part of IBM's Olympic sponsorship. Specially designed programs include database management applications to help handle transportation requirements and inventory control programs to keep track of sports equipment and personnel records.

In short, there's hardly an area of planning and staging the 1984 Summer Olympics that the IBM Personal Computer doesn't play a part in. Maybe there *should* be medals for administration.

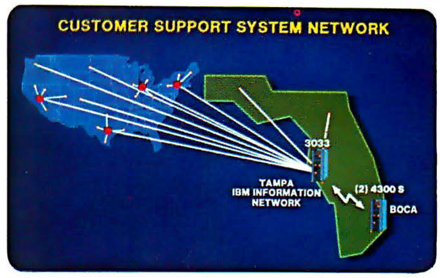
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ON THE STOREFRONT

A Shorter Distance between PC Points. We're all familiar with the feeling of being lost in the growing maze of new computer products. IBM has opened a path through that maze, straight to the information and answers you need about IBM Personal Computer Products—information about a specific software package or hardware configuration and answers to technical questions.

The key to entering this new information path is the IBM Customer Support System (CSS) at your authorized IBM Personal Computer retail dealer or IBM Product Center. Dealers in over 300 cities throughout all 50 states use the Customer Support System, which includes a nationwide communications network, to help give you instantaneous computer-age service support that's unmatched by any other computer manufacturer.



Colorful Stops along the Way. More than 1,700 authorized IBM dealers have access to a permanent and continually updated directory of IBM Personal Computer product information in IBM's Customer Support System. For a sharp color display of the type and level of information you want, visit your dealer or IBM Product Center and choose from lists of options displayed on an IBM PC color monitor. There are choices that guide you quickly and easily from product directories to in-depth product demonstrations and configuration information.

Since knowing how to take the first step is often a problem, CSS gives you a variety of possible starting points. By selecting the appropriate category—such as printers or business software—you can move to a list of specific products and then to the



Information from CSS with simple one-key commands

product demonstration you want. If you know a product name to begin with—Word Proof, for example—CSS will make an alphabetic search for it. To keep you up-to-date, there's also a special listing for new product announcements.

You can browse through the CSS displays at your own pace, pausing at a given spot or moving quickly backward or forward by using simple one-key commands that are always displayed at the bottom of the screen. One of these commands enables you to make print-outs of any information you wish to save for future reference.

The IBM PC family's color graphics capabilities make the CSS software demonstrations especially impressive. The Multiplan demonstration, for example, consists of several consecutive screens of information. Each screen is split vertically, with representative sections of the actual program on the left and explanatory text on the right. By the time you've seen the entire demonstration, you'll have a good idea of both *what* the program can do for you and *how* it does it.

Answers at the End of the Line. Over 1,000 authorized IBM retail dealers and IBM Product Centers are linked through their Customer Support System to the IBM Information Network. This nationwide communications capability helps your dealer give you fast, efficient service. Warranty claims, for instance, can be handled through CSS with a minimum of paperwork and delay. Dealers also use the network to communicate with other dealers and with IBM to keep abreast of the latest product and service information.

In addition, the CSS network is your gateway to technical information about the IBM Personal Computer family of products. IBM maintains a database on a 3033 mainframe in Tampa, Florida, that your dealer can use to answer—within minutes—a wide range of questions. If the solution isn't on hand in the database, your question can be submitted through CSS to a technical support staff in Boca Raton. There, it will be analyzed and an answer returned through CSS to your dealer.

The information used to answer your inquiry is added to the CSS database, where it will be immediately available for anyone else with a similar question. Your technical inquiries therefore contribute to the growth of the Customer Support System. Its on-line product information, color graphics displays, and advanced communications all have a single purpose—to help you get the most out of your investment in IBM Personal Computer hardware and software products.



HARDWARE NEWS

Color. There's color news for the IBM PC, IBM PC XT, and IBM *Portable* PC in the form of the IBM Personal Computer Color Printer. It's a high-performance, dot matrix printer that can print charts, graphics, artwork, and text in up to eight colors. The Color Printer produces color graphics that can enhance the appearance of your reports and presentations and make the information they contain even easier to understand. It can also type directly onto overhead transparencies.

The IBM PC Color Printer's range of performance features make it especially well suited for heavy-use/high-productivity applications. A near letter quality printing mode is standard. Printing speeds of up to 200 characters per second can help save time. So can programmable automatic control of print requirements such as print mode, line spacing, and margin and tab setting. These programmable features act as an extension of many software products—word processing programs, for instance—and can be initiated with just a few keystrokes.

A final feature for those who like a personal touch. You can use the Color Printer to personalize your documents by varying the printing modes, character spacing, and boldness. This allows you to differentiate



The IBM PC Color Printer

among headlines, subheads, and quotations and even to print math and science equations.

The Big Crunch. Not long ago, computing and number crunching were nearly synonymous. Personal computers and software for everything from office management to agriculture changed that, but the need for heavy number crunching has hardly disappeared. If it's still a part of your computer workload, the IBM Personal Computer 8087 Math Co-processor can help speed up your calculations.

The 8087 is a floating point co-processor that multiplies, divides, adds, subtracts, exponentiates, and performs trigonometric and logarithmic functions. It works together with the PC's 8088 processor to improve the execution speed of floating point operations by as much as 10:1. The Math Co-processor increases calculation speeds so greatly because it makes floating point operations a hardware rather than a software function.

In addition to increasing the speed—and often the level of precision—of statistical and analytical math packages, the Math Co-processor can improve the display speed of graphics and video games. It also significantly improves high-level language execution time, and is designed to work with the APL Interpreter and the version 2.0 Pascal and FORTRAN Compilers discussed next in this issue.



WHAT'S THE PROGRAM

We Speak Your Language. IBM Personal Computers are shameless polyglots. They can handle most of the popular programming languages you want to work with. Much of the credit for their versatility goes to the IBM Disk Operating System (DOS) 2.10. This updated version of DOS 2.00 was developed to provide support for the IBM PCjr as well as for the IBM PC, PC XT, and IBM *Portable* PC. So all members of the IBM Personal Computer family are united by a single master program that provides the required support between their hardware and a wide range of application programs.

More to our present linguistic point, the DOS 2.10 diskette contains two programs, Disk BASIC and Advanced BASIC, to help you write your own programs on an IBM PC. (IBM PCjr BASIC—a separate, optional cartridge—provides this support for the PCjr.) Disk BASIC adds DOS file support, date, time of day, and communications capabilities to the BASIC language that comes with every personal computer from IBM. Advanced BASIC adds advanced key trapping and advanced graphics—including viewports, windows, and paint tiling—plus music and other capabilities.

DOS has other features that help simplify advanced program development and design, including a line editor, a linker, background printing, and chaining of commands. For help with writing and editing particularly sophisticated BASIC programs, there's the BASIC Programming Development System, a software package that consists of two programs and four utilities. The first program includes a Text File Editor and a Structured BASIC Pre-processor; the second includes a BASIC Formatter and a BASIC Cross-Reference.

Native Translators Available. The IBM BASIC Compiler compiles or translates the BASIC programs you've written, down to native object code so they'll run on your IBM PC. And BASIC is just the beginning. DOS also provides the support you need to develop and run programs using the IBM Personal Computer Macro Assembler or the FORTRAN, COBOL, and Pascal Compilers.*

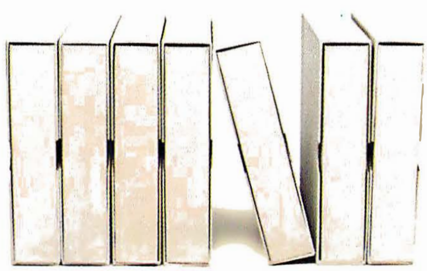
Two of these, the FORTRAN and Pascal Compilers, are available in recently updated versions. IBM PC Pascal 2.0 is based on the ISO standard, and IBM PC FORTRAN 2.0 conforms to the ANSI-77 standard subset level. Both new versions feature improved arithmetic capabilities, and both support the IBM 8087 Math Co-processor for greatly increased speed in processing floating point calculations. (For more about the Math Co-processor, see "Hardware News" in this issue of *Read Only*.)

In addition, versions 2.0 of the FORTRAN and Pascal Compilers feature a Library Manager for creating user-defined libraries and provide easy access to all files in any subdirectory through DOS path support. FORTRAN 2.0 supports linking of object modules with subroutines written in Pascal 2.0 and vice versa. Both new versions support linking of object modules with subroutines written in IBM PC Macro Assembler.

There's a bargain in store for those who already own the 1.0 versions of these compilers: you have the option of buying an upgrade to the 2.0 version at a substantial savings from the full 2.0 price.

To ensure that your programming reach doesn't exceed your grasp, the IBM PC APL Interpreter enables you to write and edit your own programs in APL. It can also be used to exchange data files and workspace between your IBM PC and many mainframe computers.*

Finally, if you're inclined to make serious use of the IBM PC's array of programming aids, we suggest that you also take a look at the recently announced IBM PC Sort program. It provides support for data types and file organizations used by the IBM DOS-supported languages mentioned above and can significantly speed and streamline your programming efforts.

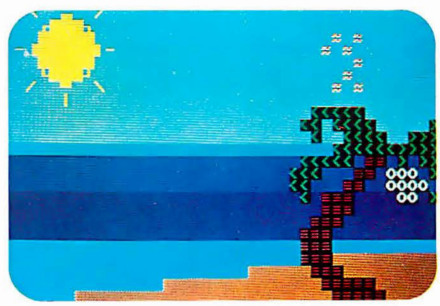


Application development tools from IBM

IBM PC Sort can be used as a stand-alone utility, integrated into a batch job stream, or invoked directly from a COBOL program via the Sort verb. It can sort records from a data file or files, merge multiple input files, selectively include or exclude records, and create an output file containing the records, pointers, or keys from the input files. There are no arbitrary limits in IBM PC Sort for file size, record length, number of keys, or number of input files.

*BASIC Compiler and Macro Assembler will run on the IBM PCjr. APL Interpreter will not. Although the IBM PCjr does not support FORTRAN, COBOL, and Pascal Compilers, most of their output will run on the PCjr if there is sufficient storage.

Now Get Organized. The IBM PC's ability to run a wide variety of commercially available programs and to help you develop your own applications may result in a good news/bad news situation. The good news is that you'll be able to satisfy your application requirements. The bad news is that you'll probably be the one responsible for keeping track of your growing library of programs. If, as we've often found, enthusiasm outstrips organization, you may find yourself falling behind—especially if you're working in an area, such as small business finance or education, where programs multiply rapidly.



Animation Creation software from IBM

Fortunately, help is in sight, in the form of Fixed Disk Organizer, an IBM software package that does just what its name suggests.

Fixed Disk Organizer has a master menu that lets you sort out your various application programs by category—word processing, spreadsheet, communications, and so on. You can tailor the menu to your specific application needs by adding new menu categories, revising or deleting existing categories, or changing titles. The master menu allows you to review all the programs stored on your fixed disk at a glance and to call them up quickly with just a couple of keystrokes.

Fixed Disk Organizer also helps protect sensitive data by allowing you to create passwords and restrict access. It also enables you to write a

string of complex DOS commands into a batch file and execute them whenever you want simply by selecting that file from the menu. And in case part of your organizational problems stem from not always remembering just how things are organized, you can use Fixed Disk Organizer to establish Help files as a reminder.

So we're all in trouble—no more excuses for not being organized.

Moving Pictures and Mathematical Castles. Let's not forget that there's more to life than programming, compiling, and getting organized. There's also software from IBM for pure enjoyment and for enjoyable education. Two such packages are Animation Creation and Adventures in Math.

Adventures in Math incorporates math drills into an adventure game with vivid color graphics of a castle and its passageways and treasures. To find the way out—and to uncover as many treasures as possible along the way—children (or particularly skillful adults) have to solve basic math problems. The program's difficulty level increases as you solve the problems you're confronted with.

Using Animation Creation, you or your children can draw your own pictures and watch them come to life. To draw pictures, you select from 254 computer characters and position them on your screen. Add color by choosing any of 16 foreground and 8 background colors. Then, by slightly repositioning the images on successive screens, you can create animation.

Next stop, Hollywood.

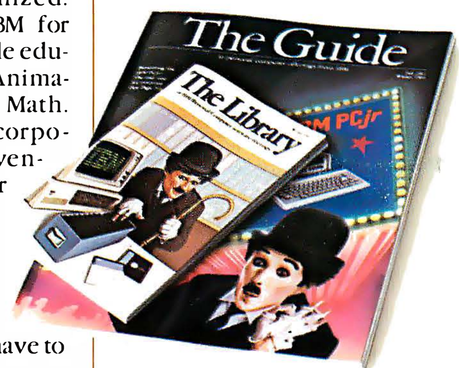


HARDCOPY

You Can't Enjoy the Game without a Program. Earlier in this issue (see "On the Storefront"), we discussed the Customer Support System for online information about IBM Personal Computer products. Much of that information is also available in two publications: *The Guide,* a directory of Personal Computer offerings from IBM, and *The Library,* a directory of IBM Personal Computer software offerings. If you want to enjoy the personal computer game, these are the "programs" you need to do it.

The Guide, published twice a year, is a catalog that contains clear, concise descriptions of IBM PC, IBM PC XT, IBM PCjr, and IBM *Portable* PC systems. It also reviews printers, video displays, expansion units, and all other IBM PC hardware products. A separate section of *The Guide* contains articles on IBM PC software packages.

Both hardware and software articles are illustrated



with annotated color photographs—of key screens for the software packages—and start with charts that provide quick product overviews. Other noteworthy features include sample configuration tables for all three systems and a closing section on Sales and Service Support.

The Library, updated quarterly, presents an overview in booklet form of the entire IBM PC software product line. It presents the software by category, with sections on Operating Systems and Languages, Personal Productivity, Communications, Business, Education, and Entertainment. Program descriptions are brief and to the point. Each includes a short overview, program highlights, and system requirements. There's also a chart at the end of the booklet that shows at a glance which programs are compatible with the IBM PCjr.

Or the Hardware without a Manual. If *The Guide* and *The Library* are the general road maps to IBM PC products, the *Technical Reference* and *Hardware Maintenance and Service* manuals*—now available in newly updated versions—are the detailed maps of downtown. It's not a trip everyone wants to take, but if you do, these are the right directions.

There's a three-volume *Technical Reference* set for the PC and another for the PC XT and *Portable* PC. These manuals include the functional specifications for the system units and for the options and adaptors in the IBM PC product line. The *Hardware Maintenance and Service* manual details many aspects of troubleshooting a personal computer from IBM. It includes a parts catalog, a section on preventive maintenance, and instructions for identifying the failure of a replacement unit.

*These manuals are intended for use by technically qualified service personnel.



TIPS AND TECHNIQUES

If you use Personal Editor—IBM's full-screen editor for writing programs and brief documents—but find yourself displaying the Help file whenever you forget a function key assignment, here's a little help from the fellow forgetful.

Function key assignments can easily be displayed on the command line of your Personal Editor screen by assigning F1 to display the unmodified keys and alt+F1 to display the alt+Fx keys. You can then assign the Help function to alt+H, although you probably won't need it nearly as often as before.

The macro for the F1 assignment can be written as follows: def f1 = [cursor command] [begin line] 'F: 2=Save 3=File 4=Quit 5=Erase 6=EraseEOL 7=Print 8=Switch 9=InsL 10=Ins&Indt' [cursor data].





IBM®

For more information about IBM Personal Computer products, see your authorized IBM Personal Computer dealer or IBM Product Center. To learn where, call 800-447-4700. In Alaska and Hawaii, 800-447-0890.

FEEDBACK

Pascal p-System Upgrade for PC XT

Maura Smith, SofTech Microsystems' director of communications, commented on James P. Reed's letter to the editor "Watch the Fine Print" (February, page 24). In his letter, Mr. Reed related his surprise when he discovered that neither UCSD Pascal p-System's program nor data files can be stored on an IBM PC XT's fixed disk.

Ms. Smith wants BYTE readers to know that SofTech Microsystems offers an upgrade kit to solve fixed-disk problems such as Mr. Reed's. This upgrade allows you to store both programs and data on the IBM PC XT's hard disk, and it lets you partition a disk among various operating systems.

The upgrade is available through SofTech's end-user sales department for $20. The address is SofTech Microsystems, 16885 West Bernardo Dr., San Diego, CA 92127, (619) 451-1230.

DEVELOPMENTS

Product News

QDP Computer Systems of Cleveland, Ohio, has announced a 15 percent price reduction on its entire line of QDP-300 business and industrial desktop micros. Prices begin at $3495 for a single-user system with two floppy-disk drives and 128K bytes of RAM.

ASHTON-TATE's dBASE II database-management system will now be bundled with Kaypro 4 and 10 computers shipped after April 4, according to Kaypro Corporation. In a related development, Kaypro revamped the software package that comes with each of its computers. The new bundle features Digital Research's CP/M 2.2 and MicroPro International's WordStar, MailMerge, CalcStar, and MBASIC. Incidentally, if you're wondering why Kaypro changed the name of the Kaypro II to Kaypro 2, a company spokesperson explained that it was because people kept asking to see a Kaypro *eleven*.

MICROPRO International, the San Rafael, California, applications-software developer, has announced that its WordStar Professional package is available for the Tandy 2000. The Professional package is made up of the WordStar word processor, the CorrectStar spelling corrector, the MailMerge file- and data-merging program, and StarIndex, which creates tables of contents and alphabetized indexes. MicroPro claims to have sold 800,000 copies of WordStar.

LOTUS Development Corporation's 1-2-3 is now available for the IBM PCjr. The Cambridge, Massachusetts, software developer has set the suggested price for this integrated package at $495.

SOFTWORD Systems Inc. has changed its name to MultiMate International Corporation. According to a company spokesperson, the public's recognition of the name MultiMate is higher than its recall of the name SoftWord Systems. This is due to the fact that the name of each of the company's products begins with the word "MultiMate." The word "International" reflects the company's expanding overseas customer base. MultiMate International, which produces word processors and database and list managers, maintains corporate headquarters in East Hartford, Connecticut.

TERRAPIN LOGO's suggested retail price has been reduced to $99.95, according to a recent announcement by its Cambridge, Massachusetts-based publisher, Terrapin Inc.

LEADING EDGE Products of Needham, Massachusetts, has reduced the price of its Leading Edge Word Processor to $200, in response to IBM's announcement that it will market a version of Displaywriter for the PC.

NETWORK UPDATES

Database Serves Financiers

Invest/Net, billed as the insider's trading monitor, is said to feature complete up-to-the-minute information showing the buys, sells, and options exercises of corporate insiders, including senior officers, directors, or owners of 10 percent or more of a corporation's stock. You can also browse the entire list of stocks traded in the United States, scan specific industry groups, and assemble data covering any period of time. A talk-back feature lets you communicate with Invest/Net or other users. The transactions are taken from the records of the Securities and Exchange Commission as well as the New York and American stock exchanges.

Invest/Net can be accessed by any personal computer or terminal equipped with a 300- or 1200-bps modem. Most commands require a single keystroke, and a help facility is on line. It's available in more than 240 cities worldwide. For contract fees, contact Financial Information On-Line—Invest/Net, 99 Northwest 183rd St., North Miami, FL 33169, (305) 652-1710.

Collectibles On Line

The Collector's Data Service, a database for collectors and connoisseurs, went on line last month. This service provides an exchange for buyers and sellers of such sought-after items as oriental rugs, exotic real estate, works of art, classic cars, antiques, and other collectibles. Lists of stolen properties are carried, along with newsletters, event calendars, and show and auction listings. Additional features include on-the-spot credit validations and low-cost classified notices.

Access is via Tymnet. Further information is available from the Collector's Data Service Ltd., 420 West Mercer, Seattle, WA 98119, (800) 435-0100; in Washington, (206) 281-7273.

Pharmaceuticals Focus of New Network

GTE Telenet Communications Corporation and Fisher Stevens Inc. have introduced PHYCOM (Physicians Communications). PHYCOM is reported to be the first on-line version of the *Physicians Desk Reference*, which contains information on nearly 1000 trade-named pharmaceutical products, product profiles, details of patients' reactions, abstracts of papers by physicians with prescribing experience, and a bibliography of clinical studies.

Up and running since early April, PHYCOM provides daily news bulletins on medical and regulatory developments from the Bureau of National Affairs. A special emphasis is placed on government health-care rulings and medicolegal decisions. A request service enables doctors to contact sponsoring drug companies for product literature or samples, order reprints of published papers, and register for seminars and symposia.

Most of PHYCOM's information can be obtained free of charge, because the cost of providing this service is shared by the sponsoring companies. PHYCOM is available through GTE Telenet's MINET medical-information network. For further information, contact GTE Telenet Communications Corp., 8229 Boone Blvd., Vienna, VA 22180, (703) 442-1000.

Electronic Mail System for Deaf Uses Standard Telephone

Subscribers access the Deaf Electronic Mail Service's (Deaf-EMS's) computer through their TTY or TTD (teletyping devices) in the same manner they would place a call to a friend. Serving as a community bulletin board and electronic mail system for the hearing impaired in the Seattle, Washington, area, Deaf-EMS provides users with mailboxes and schedules of such events as captioned films, national deaf sports, and local club and service organization announcements. Health, safety, and other public-service announcements are covered.

(continued)

Developed by Silent Software Services, Deaf-EMS does not require users to purchase additional equipment or modify their hardware. Deaf-EMS's interface converts the 5-bit Baudot TTY letter code to the 7-bit ASCII code used by its computer, which facilitates ease of use.

Silent Software Services was founded by Paul Stefurak of Seattle. Deaf since birth, Mr. Stefurak earned a degree in mathematics from Gallaudet College for the Deaf in Washington, D.C. For more information contact Silent Software Services, 3864 Beach Dr. SW, Seattle, WA 98116, (206) 937-5386 (voice or TTY).

INTERACTION

Analyses Can Be Risky Business, But Maybe Not That Risky

Professor William Lyons from the University of Tennessee's political science department wrote us suggesting the possibility of a "substantive error" in Pat Macaluso's article "A Risky Business—An Introduction to Monte Carlo Venture Analysis" (March, page 179). We wrote to Mr. Macaluso requesting his opinion on the issues raised by the professor. Here are some excerpts f om both letters.

"Pat Macaluso," writes Professor Lyons, "gives the strong impression that one makes estimates of the standard error of the sample means of a particular size drawn from a population only through repeated sampling. In fact, one would not use the sample standard deviation of $13,400 if one had conducted one sample, as is suggested on page 190: 'If we had made only one run of 2000 samples, we would have little idea of how we were doing. The large standard deviation of $13,400 would have left us with a range of about $14,000 to $41,000 in which to expect the average in 2 out of 3 chances.'"

Professor Lyons contends that you would not use the standard deviation of the cases in such a manner. In his opinion, the appropriate technique would be to use an estimate of the standard deviation of the means. You can estimate this by dividing the standard deviation of the one sample taken (i.e., $13,400) by the square root of the sample size minus one [$\sqrt{(2000-1)}$]. This phenomenon lets researchers make estimates of population parameters after having conducted a single sample.

In his reply, Pat Macaluso agrees with Professor Lyons that you should not use a sample standard deviation as an estimate of the population value, and he confirms that you should first divide by the square root of the sample size. The purpose of the 10-run method used in the article, notes Mr. Macaluso, was to get a fix on the sample size. Consequently, he asserts the validity of the use of sample standard deviations in that context.

He does, however, differ with what he sees as Professor Lyons's suggestion that you could do as well by making a single run of *N* samples. Such an avenue may be justifiable for a survey where sampling is expensive, but it would be unwise when sampling a model on a computer.

"Suppose we made a single run of 200 samples," suggests Mr. Macaluso. "A typical result would be about $27,600 plus or minus 950 . . . not bad for a two-thirds chance of bracketing the true (model) average. It could well satisfy an analyst. Still, the 10-run method requires a sample size of 2000 and uses the averages from 10 runs of 200 samples each to approximate the population parameters. My approach makes allowance for the iffy nature of the model, the number of variables, and the economy of sampling on a computer.

"The analyst can see how data that are often skewed settle down to a fairly normal sampling distribution with diminishing variation. This makes the process more understandable and helps settle on a larger, yet more practical, sample size. Managers risking large sums of money appreciate the conservatism of this approach."

Internal Circuitry Compensates for Possible Bug

David L. Gaissert, an evaluation engineer with NCR Corporation in Peachtree City, Georgia, spotted a bug in the BASIC program accompanying Joe D. Blagg's article "A Low-Cost, Low Write-Voltage EEPROM" (February, page 343) and is concerned about a possible error in the circuit Mr. Blagg described.

In listing 1 on page 344, the program does not increment the EEPROM address pointer, which is the variable *P*. This results in programming all 2048 bytes of RAM into a single address, 14336. To correct this problem, add this line to the program: 265 P=P+1.

While scrutinizing Mr. Blagg's example of interfacing the 52B13 EEPROM to a Z80-based system, Mr. Gaissert noticed that a one-shot was used to extend the Z80's bus-write pulse to a nominal 10 milliseconds. He felt that the interface does not have provisions for latching the data until the write pulse times out. The integrity of the data to be written would then be lost even before the EEPROM had a chance to complete the programming process.

Mr. Blagg has informed us that this would be true when programming a conventional PROM, such as the 2716, but not with Seeq Technology's 52B13 EEPROM. Seeq's chip has its own data-latching network as a part of its internal circuitry. Once it detects the leading edge of $\overline{WE}$, the 52B13 latches in all other input signals, including data, addresses, $\overline{CE}$, $\overline{CC}$, and $\overline{OE}$. The system controller only has to maintain the $\overline{WE}$ signal during the write cycle after the latches are activated. This feature was one of the reasons Mr. Blagg found the chip so easy to use.

While on the subject of Seeq Technology, Mr. Blagg provided us with some supplementary materials to pass on to you. Seeq is producing the 52B13 (at the time Mr. Blagg wrote his article, only production samples were available). It's distributed nationwide by Schweber Electronics, Jericho Turnpike, Westbury, NY 11590, (516) 334-7474, which maintains outlets in 30 cities. At press time, the 52B13 is available in 350- and 250-nanosecond versions for $23 or $27.50 each (quantity 1 to 24). Seeq Technology is located at 1849 Fortune Dr., San Jose, CA 95131, (408) 942-1990.

(continued)

Free and Easy

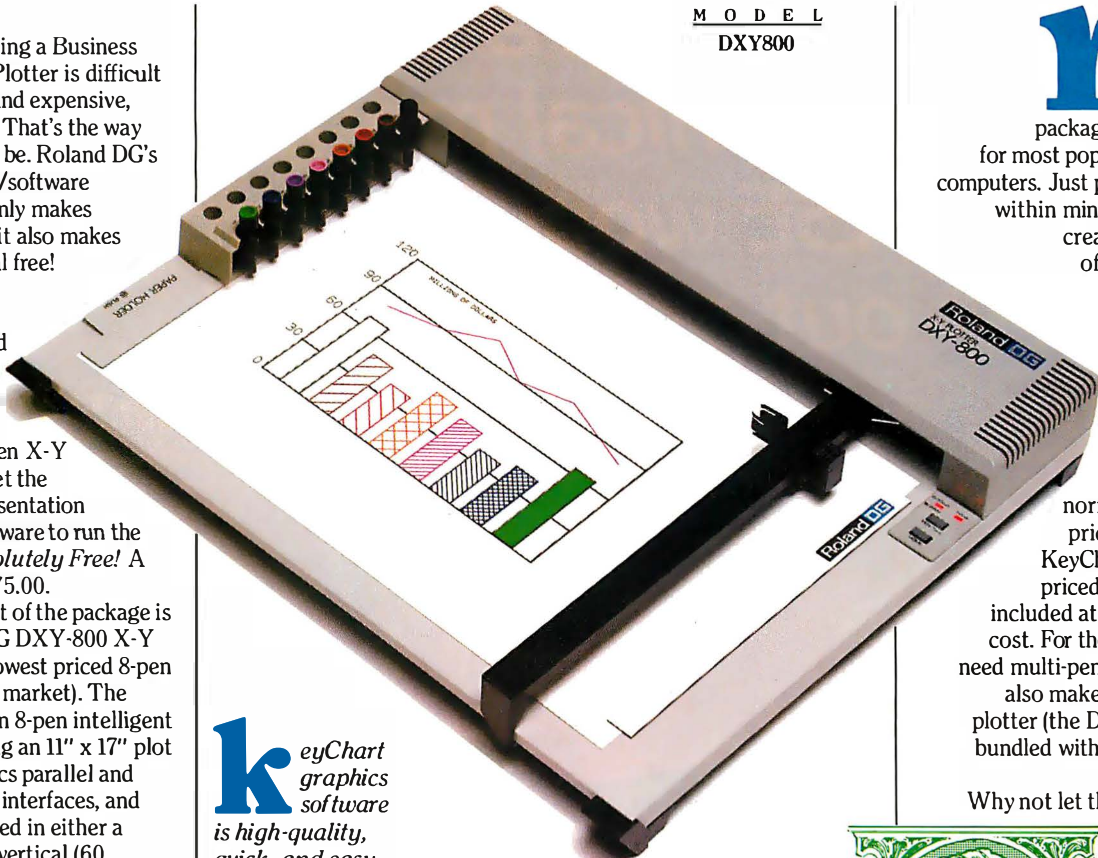
Using a Business Plotter is difficult and expensive, right? Wrong! That's the way things used to be. Roland DG's new hardware/software package not only makes plotting easy, it also makes part of the deal free!

During the months of April, May and June with the purchase of a Roland DG DXY-800 8-Pen X-Y Plotter, you get the KeyChart Presentation Graphics Software to run the plotter—*Absolutely Free!* A savings of $375.00.

At the heart of the package is the Roland DG DXY-800 X-Y Plotter, (the lowest priced 8-pen plotter on the market). The DXY-800 is an 8-pen intelligent plotter offering an 11" x 17" plot bed, Centronics parallel and RS-232 serial interfaces, and can also be used in either a horizontal or vertical (60 degree inclined) position, to conserve your desk-top space. Use regular paper or even acetate to produce overhead projection graphics.

Next add KeyChart, probably the quickest, and easiest software program for generating presentation-quality business graphics. You don't have to be a programmer to use KeyChart. It is completely menu-driven and can provide automatic default values for every characteristic. Load in your data from the keyboard, or from almost any electronic spreadsheet, including Lotus 1-2-3.

MODEL
DXY800



KeyChart graphics software is high-quality, quick, and easy.



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Roland DG's DXY-800 KeyChart package is available for most popular personal computers. Just plug it in, and within minutes you'll be creating the kind of graphics you thought might take days of programming. All of this comes to you for the DXY-800's normal low retail price of $995.00. KeyChart, normally priced at $375.00 is included at no additional cost. For those who don't need multi-pens, Roland DG also makes a single pen plotter (the DXY-101), also bundled with KeyChart for only $750.00

Why not let the Roland DG graphics system improve the quality of your business presentations? But you'd better hurry, this kind of free and easy dealing isn't going to last forever, just until June 30th. For a dealer near you contact: Roland DG, 7200 Dominion Circle, Los Angeles, CA 90040, (213) 685-5141.



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April 1984



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The Ratings Newsletter
Software Digest, 1984

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Features	Menu driven with built-in commands	•			•
	Full application development functions	•	•		
	Applications can be modified by user	•			
	Menus can be defined by user	•			
	Over 200 fields/record & characters/field	•		•	
	More than 8 indices per file	•			
	More than 16 concurrent open files	•			
Data Entry	Full screen editing for form creation	•		•	•
	Selection from predefined choices	•			
	Valid options always displayed	•			
	Table look-up, dollar and date fields	•		•	•
	Checks for duplicate records	•		•	
	Form modification with auto file update	•			•
Reports & Queries	Query selection through English prompts	•			
	Multiple field sort	•		•	
	Create form letters and mailing labels	•			
	Update multiple files concurrently	•		•	
	Update data between files	•	•		
Interfaces	Read/write both DIF and ASCII	•		•	
	Menu integration with 1-2-3/MultiMate, etc.	•			



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Bug in Early 8088 Arises Later, Reader and Author Explain Fix

BYTE reader Martin Janzen of PBSC Software in Winnipeg, Manitoba, found J. Eric Roskos's article "Writing Device Drivers for MS-DOS 2.0: Using Tandon TM100-4 Drives" to be both interesting and informative. (See February, page 370.) However, the routines in which a local stack is created for the device driver, listing 2 on page 374, concerned him. It seemed to Mr. Janzen that the two groups of instructions (i.e., to switch to a local stack and to switch back to the DOS stack) could produce unpredictable results, such as overwriting areas of memory or storing registers in nonexistent memory.

Listing 1: *Martin Janzen's solution to prevent unwanted interrupts from disrupting critical sections.*

```
dev_strategy:
      ;switch to local stack
    cli                          ;turn off interrupts
    mov   spsav,sp               ;save DOS's stack pointer . . .
    mov   sssav,ss               ;  . . . and stack segment regs
    mov   ax,cs                  ;set up a local stack in this
    mov   ss,ax                  ;  code segment
    mov   sp,offset stkbot       ;bottom of local stack
    sti                          ;allow interrupts to occur


      ;switch back to DOS's stack
    cli                          ;turn off interrupts
    mov   ss,sssav               ;restore DOS's stack segment
    mov   sp,spsav               ;  . . . and stack pointer
    sti                          ;allow interrupts to occur
    ret                          ;  after 'ret' instruction
```

"Each [group of instructions] makes up a critical section; a sequence of instructions which may not be interrupted," explains Mr. Janzen. "For example, if an interrupt were to occur after the MOV SS,AX instruction had been executed, but before the MOV SP, OFFSET STKBOT instruction, the interrupt mechanism would push the CS and IP registers onto a stack pointed to by the new value of the SS register and the old value of the SP register."

Mr. Janzen's solution (see listing 1) is to surround each critical section with CLI (clear interrupt flag) and STI (set interrupt flag) instructions. This prevents the interrupts from being processed until the critical section is complete and the stack has been moved.

"If a critical section occurs inside an interrupt-handling routine," says Mr. Janzen, "then the interrupts will already be disabled when the routine receives control. Provided that the routine never executes an STI instruction, the critical section will always execute correctly. However, it is not good to leave interrupts disabled for too long, so this method is not practical for any but the shortest interrupt handlers."

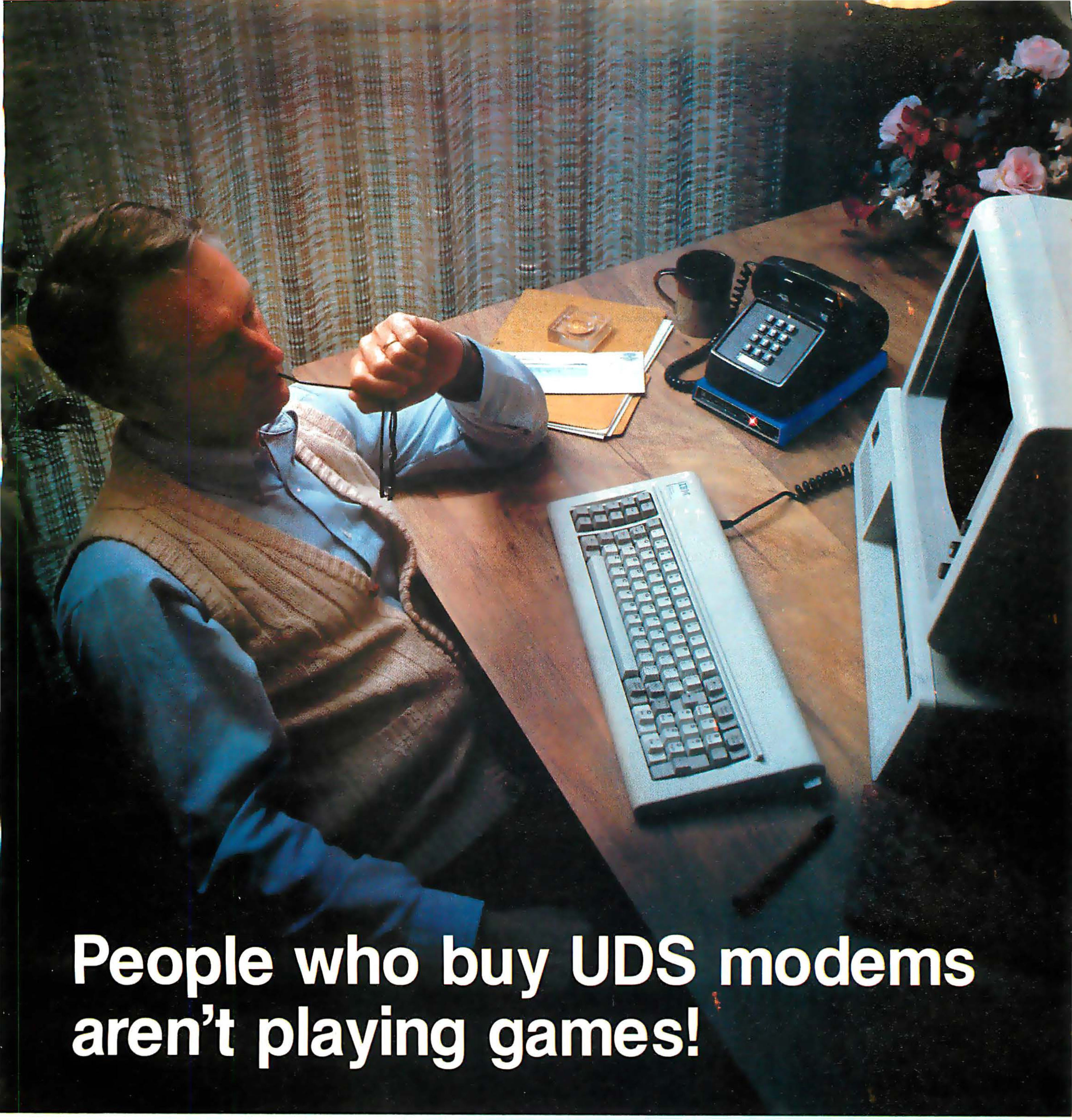
"Whenever a MOV or POP instruction is executed specifying a segment register as the destination," says Mr. Roskos, "interrupts are automatically suppressed until after the next instruction is executed. Intel designed the instructions this way . . . to handle the case Mr. Janzen describes. Thus, it is not necessary to surround the sequence MOV SS, AX . . . with a CLI/STI pair [because] the first of the two instructions will cause interrupts to be ignored until after the second of the two is executed."

Mr. Roskos stressed that Mr. Janzen could well have found that the program did not work on his machine. He told us that the problem existed in some of the older IBM PCs, which had a bug in the 8088's microcode. Long after writing his article, Mr. Roskos came across Will Fastie's "Tracing a Bug in the 8088" (PC *Tech Journal*, September-October 1983, page 106). The article described an error in the 8088 processor that was shipped with some of the earlier IBM PCs. This bug prevented the disabling of interrupts following a MOV or POP to the stack segment from working correctly—precisely the difficulty encountered by Mr. Janzen. Mr. Roskos verified the error by using an old 8088 microprocessor he had, but he defended his program as being correct according to Intel's specifications for the 8088 microprocessor. In addition, it works with all IBM PCs, except for those few early releases with the faulty microcode.

Although Mr. Janzen's solution is workable for machines with a defective 8088, Mr. Roskos offers a caveat regarding the use of CLI/STI pairs to protect stack switching. In some routines the interrupts must remain disabled and that using a CLI/STI pair turns on interrupts at the end of the critical section you're protecting. This can cause complications if the protected section resides inside a larger block of code that is supposed to be run with the interrupts off.

If such a situation as described here were to arise and you wanted to protect the stack switches, you must first verify that the interrupts will always be on at the start of the critical sec-

(continued)



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tion. Otherwise, you'll re-enable them, producing errors. Often this can be avoided by turning off the interrupts (using PUSHF/CLI/POPF) and then restoring them to their previous state. In the case of a stack switch, this won't work, so you must analyze the code before adding CLI/STI to the program.

Our thanks to Mr. Janzen and Mr. Roskos.

Statement Draws Fire, Authors Stand By Words

Nicholas Ourusoff, associate professor of computer science at Lander College in Greenwood, South Carolina, disagreed with a statement made by Mark C. Johnson and Allen Munro, authors of "Pascal's Design Flaws: Modula-2 Solutions and Pascal Patches" (March, page 371). He objected to their assertion that "... the Pascal-language definition does not permit . . . short-circuited evaluation—cessation of the evaluation when the expression is false."

To back his argument, Mr. Ourusoff sent us this quote from the second edition of Jensen and Wirth's *Pascal User Manual and Report* (Springer-Verlag, 1978):

Boolean expressions have the property that their value may be known before the entire expression has been evaluated. Assume, for example, that x=0. Then

$(x>0)$ *and* $(x<10)$

is already known to be false after computation of the first factor, and the second need not be evaluated. The rules of Pascal neither require nor forbid the evaluation of the second part in such cases.

"In general," concludes Mr. Ourusoff, "Jensen and Wirth have little to say about implementation of Pascal in this book, being mainly concerned with the language definition itself. In Boolean expressions, however [and contrary to what Johnson and Munro state], implementors of Pascal are explicitly given the freedom to use short-circuited evaluation if they choose."

Mark Johnson and Allen Munro agreed their statement was somewhat misleading. What they had intended to say was "the definition does not *provide* . . . short-circuited evaluation."

They do, however, stand by their statement. They counter Mr. Ourusoff's accusation by completing the quote from Jensen and Wirth: "This means that the programmer must assure that the second part is well defined."

They feel that Jensen and Wirth were telling programmers that they should assume that short-circuited evaluation will not be provided by the implementation.

Skeleton Credited to Wrong Body

An editing error in the March BYTE incorrectly credited David Zeltzer's picture "Jumping Skeleton" to the wrong organization. (See "Simulating Reality with Computer Graphics," by Peter R. Sørensen, page 106.) Mr. Zeltzer did his work at Ohio State University's Computer Graphics Research Group, with the support of the National Science Foundation. ■



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Advanced Personal Computer Has UNIX

NEC Information Systems' Advanced Personal Computer III is an IBM PC compatible offering UNIX functionality. The MS-DOS operating system and GW BASIC are standard, and the multitasking, single-user UNIX System III operating system is available with special memory-management hardware.

Three basic Advanced Personal Computer III configurations are offered: a single 320K-byte floppy-disk drive system; a dual-drive system; and a system with an integrated 10-megabyte Winchester-disk and a single floppy-disk drive. All models have an 8-MHz NEC PD8086 (16-bit) microprocessor, 128K bytes of RAM, 8K bytes of nonvolatile CMOS memory, and 32K bytes of ROM for bootstrapping, diagnostics, and ROM BIOS. I/O facilities are made up of a Centronics parallel interface, an RS-232C port with both asynchronous and synchronous communications at speeds of up to 9600 bps, and monochrome and color (RGB) monitor interfaces. A hardware calendar/clock and IBM character sets are supplied.



The Advanced Personal Computer III's 61-key IBM Selectric-type keyboard is supplemented with a numeric keypad, cursor-control keys, calculation keys, and 12 user-definable function keys that can be used in five modes for 60 total programmed definitions. Both monochrome and color systems use 14-inch, reduced-glare monitors. The display format is 25 lines by 80 columns; character cells are 8 by 16 pixels. Graphics resolution is 640 by 400 pixels. The graphics option gives the system 64K bytes (monochrome) or 192K bytes (color) of dedicated memory. Each pixel can have any one of eight colors. The monochrome and graphics subsystems are based on the NEC 7220 graphics-display controller.

Other options include up to 640K bytes of RAM, RS-232C and IEEE-488 interfaces, a memory-management unit that protects multitasking operations in the UNIX environment, and joystick interfaces and sound effects. The system runs all generic MS-DOS software in IBM 5¼-inch formats; a complete list of available applications software is available through CompuServe and The Source.

A 256K-byte Advanced Personal Computer III with the floppy-/hard-disk combination, UNIX software, and UNIX hardware costs $5320. The UNIX software features a C compiler, RAND editor and Berkeley UNIX editor, 8087 coprocessor and emulation, coresidence with MS-DOS on hard disk, file transfers to and from MS-DOS, and C-Shell from Berkeley UNIX. The single-drive system with a 14-inch monochrome monitor is $1995. A monochrome system with the hard- and floppy-disk combination is $3995. For more information, contact NEC Information Systems Inc., 1414 Massachusetts Ave., Boxborough, MA 01719, (617) 264-8000.

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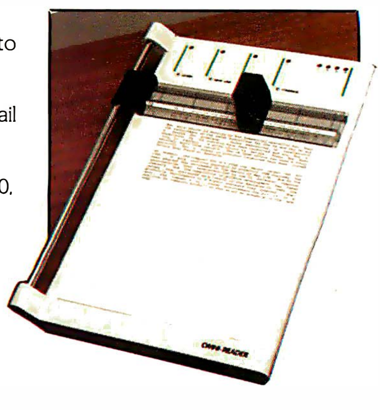
Inexpensive Optical-Character Reader for Micros

The Omni-Reader from Oberon International is an inexpensive optical-character reader for microcomputers. It links to your computer or word processor in the same manner as a telephone modem. Omni-Reader is operated manually and is reportedly faster than top-rated typists. It reads at less than 4 seconds per line.

Omni-Reader consists of a light-sensitive scanning head, a specially grated ruler, and intelligent software. You pass the head over a line of text, using the ruler to facilitate accurate registration on the line. The special grating on the ruler is sensed so as to determine how fast and in which direction you are scanning a line. This method captures a series of vertical slices across the line of characters. These characters are analyzed by a dedicated microprocessor that uses a number of algorithms to process a line of recognized text for transmission to your computer. The algorithms allow the software to discern a variety of type fonts and learn nonstandard fonts.

Omni-Reader's suggested retail price will be under $500. For more information, contact Oberon International, Suite 630, LB 48, 5525 MacArthur Blvd., Irving, TX 75062, (214) 252-8453. In the United Kingdom, the address is 47 Romney St., London SW, England; tel: 44 1 222 0518.

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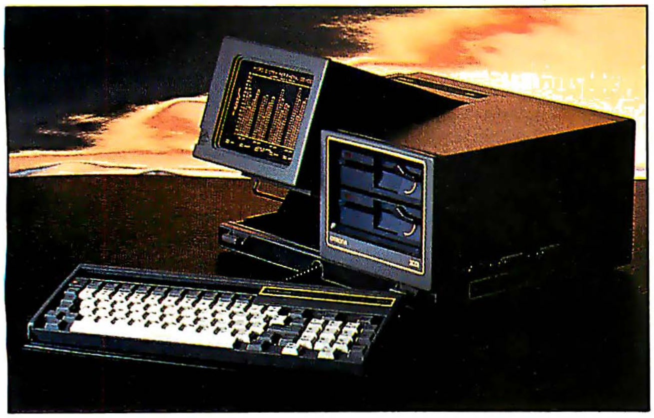
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Otrona's PC-Compatible Portable Easily Converts to Desktop Computer



The Otrona 2001, a portable computer that easily converts to a desktop system, is fully compatible with the IBM PC. Its architecture offers three PC-compatible expansion slots, and its operational compatibility embraces all IBM software, such as Lotus 1-2-3 and Multiplan.

The basic Otrona 2001, retailing for $2495, comes with a single 48-tpi 360K-byte floppy-disk drive, a 4.77-MHz 8088 microprocessor, 128K bytes of RAM with parity, 64K bytes of ROM with diagnostics, a 7-inch amber flat-screen display, a serial RS-232C asynchronous port, a parallel port, and a composite-video/RGB external monitor interface. The low-profile, 84-key DIN 30-mm keyboard is equipped with 10 function keys, a 15-key numeric pad, uppercase/lowercase LED indicators, and a 16-keystroke buffer. The display format is 80 by 25 with a standard resolution of 640 by 200 pixels. The Otrona 2001 weighs 19 pounds and measures 7 inches high, 15 inches wide, and 14 inches deep.

Expansion options include a 10-megabyte internal hard-disk drive, a second 5¼-inch floppy-disk drive, up to 640K bytes of RAM, a 4.77-MHz Z80B microprocessor with CP/M, an 8087 mathematic coprocessor, real-time clock, internal 300/1200-bps auto-dial modem, high-resolution (640 by 200) graphics board, and additional asynchronous and synchronous I/O ports. A 7-inch P-31 green-phosphor monitor, a 12-inch color display, a dot-matrix printer, DC power supply, a travel pack, and a PC-compatible expansion chassis are also available. Otrona offers Microsoft MS-DOS version 2.1 with Disk Manager 2 and GW BASIC, CP/M 2.2, and BASIC-80 Plus as system software.

The Otrona 2001 is available for immediate delivery. For the name of your nearest dealer, contact Otrona Advanced Systems Corp., 4725 Walnut St., Boulder, CO 80301, (800) 525-7550; in Colorado, (303) 444-8100.

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StarLink Expands IBM PC into Multiuser Micro

A hardware/software combination to expand the IBM PC into a multiuser system, StarLink from Digital Research provides a low-cost alternative to purchasing multiple computers. With StarLink, you can connect four terminals or microcomputers to your IBM PC, with users sharing files, data, and applications.

StarLink is made up of an 8088-based board, 64K bytes of RAM, and Concurrent PC-DOS (see announcement on page 50). Its on-board RS-232C interface lets you use the IBM PC along with terminals, modems, and computers from other manufacturers. The operating system has protection and file-locking functions.

StarLink can run such applications programs as WordStar, MBA Accounting, and Multiplan. It requires an IBM PC, PC XT, or PC compatible with 512K bytes of RAM. The list price is $1695. Contact Digital Research Inc., 160 Central Ave., Pacific Grove, CA 93950, (408) 649-3896.

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Light Pen Works with Apples

The Gibson Light Pen, available from Koala, lets you create and manipulate objects on the Apple's screen. It's easy to judge and control the Gibson Light Pen because it comes in direct contact with the screen. Color can be added or changed as often as you like, and you can choose from a variety of presupplied colors and patterns to paint areas of your art.

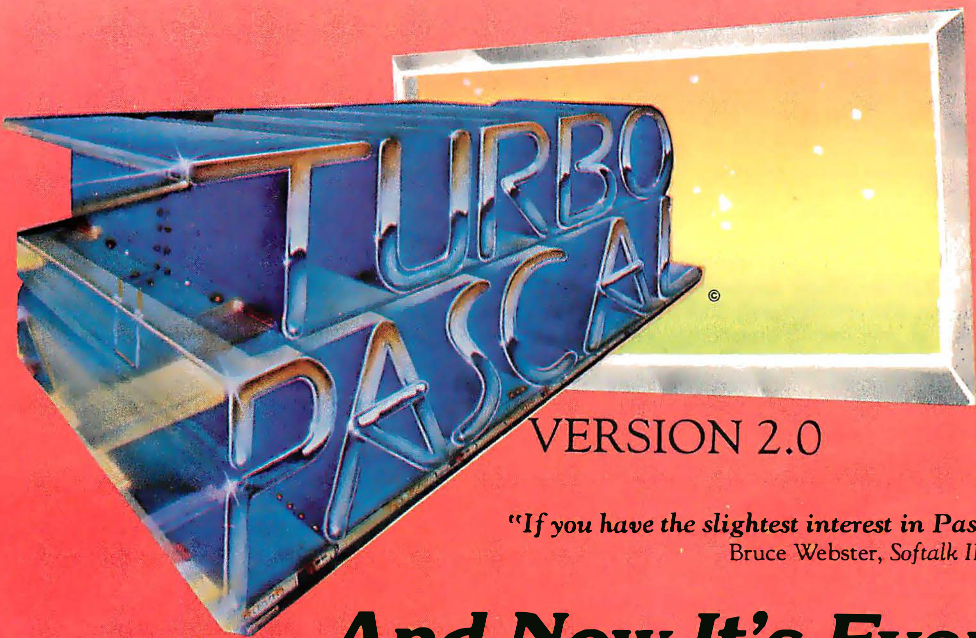
The heart of the Gibson Light Pen is software. Four programs come with the pen, and Koala intends to expand software offerings in the future. The programs are PenPainter, PenAnimator, PenMusician, and PenDesigner. PenPainter is a color graphics program for artistic applications. PenAnimator serves as an introduction to animated computer graphics. It lets you create 20 frames of animation that can be cycled through the monitor. PenMusician shows you how to score simple melodies. It uses the Light Pen for moving notes across the staff lines, and it plays back the melodies. PenDesigner is a black-and-white line art program for technical or business graphics. It provides the means for producing professional-quality graphics.

The Gibson Light Pen is currently being shipped for the Apple II series. System requirements are 64K bytes of RAM, Applesoft in ROM, DOS 3.3, a disk drive, and a monitor. Versions for the Commodore 64 and the IBM PC and PCjr are expected by year's end. It lists for $249. Further information is available from Koala Technologies Corp., 3100 Patrick Henry Dr., Santa Clara, CA 95052-8100, (408) 986-8866.

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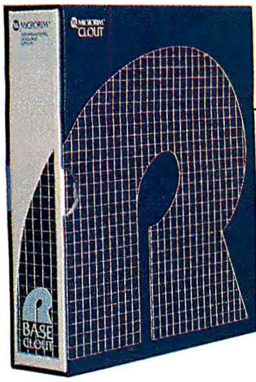
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Microrim's Clout is a natural-language inquiry option for the R:base Series of relational database-management systems. It lets you pose questions to your database in free-form English words and phrases without fussing with command syntax or database structures.

Clout incorporates expert system theory and natural-language techniques from artificial-intelligence technology. It extends the power of the R:base Select command by allowing you to retrieve information from up to five files. Upon installation, Clout reads the attributes in an existing database and adds them to its built-in 200-word dictionary. It then lets you build on the dictionary with synonyms for words or operations associated with the database.

Clout has the ability to search through the database to retrieve records based on adjectives or qualifying words, and it allows you to define words in terms of the result of computations or data manipulation. Clout can be used with any R:base database. You can add approximately 500 words of your own. Information requests incorporated into Clout can take almost any form possible, including arithmetic expressions, uppercase/lowercase characters, singular or plural words, and any standard verb conjugation. Other features include an automatic spelling checker, automatic report formatting, menu-driven functions, and more than 60 Help screens.

Clout requires an MS- or PC-DOS 1.1 or higher system with 256K bytes of memory. Although Clout will operate on a dual-disk-drive micro, a hard-disk system is recommended. Any 80- or 132-column ASCII printer can be used. Clout is $195. For complete details, contact Microrim Inc., 1750 112th Ave. NE, Bellevue, WA 98004, (206) 453-6017.

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Low-Cost Screen Graphics for PC

Fontrix 2.0 is a low-cost, extended-screen graphics software package for IBM PC and PC XT computers. Fontrix, first introduced for the Apple more than a year ago, gives your monitor a window on a large graphic worksheet, moving across nearly 23 times the area and resolution of a single screen (up to 115 screens with a hard disk). Its drawing and painting routines work with both a keyboard and a mouse.

Among Fontrix's programming tools are elastic lines, rectangular area fills, freehand drawing, and the ability to capture, move, and replicate portions of the screen. Text can be intermingled with graphics. The italic and bold functions are automatic, and you can change fonts at any time. It comes with 11 fonts and with a font editor capable of creating a variety of characters, including special symbols. The font editor provides a 48- by 48-pixel character cell environment and offers such features as copy and overlay.

Fontrix's graphics dump prints single and extended graphics on most popular dot-matrix printers, including Epson, Mannesmann Tally, NEC, C. Itoh, and Okidata. The dump features independent horizontal and vertical magnifications, 90-degree rotation, justifications, and multiple copies.

Optional libraries of additional fonts are available. Each volume contains 10 fonts. The five volumes of the library list for $20 each. The Apple version of Fontrix, which costs $75, requires 48K bytes of RAM, Applesoft in ROM, and a disk drive. It works with the Apple II Plus, IIe, and III. The IBM Personal Computer version requires 256K bytes of memory, a graphics board, and PC-DOS 2.0. It lists for $125. Contact Data Transforms Inc., 616 Washington St., Denver, CO 80203, (303) 832-1501.

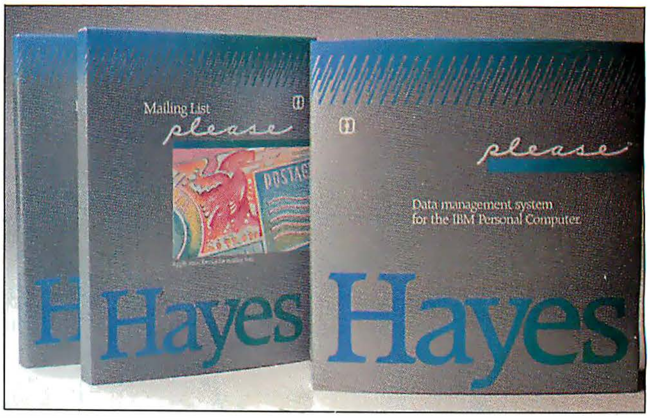
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Please Database System Is Easy to Use

First-time users of Please, Hayes Microcomputer Products' database-management system for the IBM Personal Computer, can create a database shortly after they sit down at the keyboard according to the manufacturer. A menu-driven package, Please has 999 characters per field, 99 fields per record, 2000 characters per record, and the ability to accommodate several million records per database, depending on your system's capacity. It lets you quickly change the structure of the database, merge and copy databases, and transfer data rapidly. Four different field types let you shape output to specific needs, and Please gives you the option of setting your screen formats and field characteristics.

Please has an Import/Export feature that transfers data to and from other sources, such as Lotus 1-2-3, dBASE II, Friday!, and VisiCalc. Instructions for inputting data from these and other popular programs are provided in the operator's manual. For one-time needs, Quick List retrieves selected information from a database according to specific criteria. Output Plans, comprising List, Form, Replacement, and Export functions, manipulate selected information. The List Output Plan produces columns of information from a database, while the Form function allows data to be printed in a predetermined location on a form or mailing label. Replacement makes mass deletions, and Export sends information to spreadsheets, word-processing files, and other programs.

Please's Define mode lets you create new fields in the Output Plans based on files within the record. While the original record remains on screen, Dial automatically calls a telephone number from the record using Hayes Smartmodem. Additional



features include nine-digit decimal precision, a maximum of nine screens per record, and on-line Help facilities. Optional applications templates expand Please further. These templates focus on such common database-management needs as mailing lists, contacts, appointments, and household records.

Please requires a 128K-byte IBM PC equipped with a monochrome or color monitor and either a pair of double-sided, double-density drives or a hard-disk drive. It costs $349. The applications templates list for $29.95. For the name of your nearest dealer, contact Hayes Microcomputer Products Inc., 5923 Peachtree Industrial Blvd., Norcross, GA 30092, (404) 449-8791.

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CONTROL DATA

Circle 82 on inquiry card.

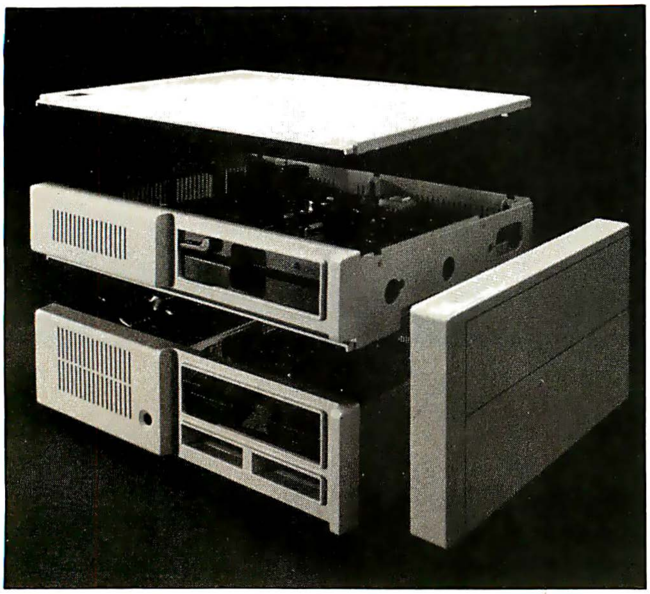
Kit Extends PCjr Up to 512K

The Drive Two Enhancement Package is a two-piece, snap-on expansion kit for the IBM PCjr. Manufactured by Rapport Corporation, this kit extends the capabilities of the 64K-byte, single-drive PCjr to those of a dual-drive IBM PC. With the Drive Two, you can run virtually any software designed for the PC as well as PCjr software.

The Drive Two kit comes with a 360K-byte floppy-disk drive, a clock/calendar with battery backup, a parallel printer port, and an expansion slot for increasing the PCjr's RAM to 512K bytes. Once installed, this package lets you operate PC-DOS 1.1, 2.1, or 2.0. Installation is said to take less than 10 minutes, requiring only a flat-head screwdriver. The kit snaps on top and to the side of the PCjr box and uses the original PCjr cover.

The Drive Two Enhancement Package costs $675. For more details, contact Rapport Corp., Suite 213, 80 South Redwood Rd., North Salt Lake City, UT 84054, (801) 292-9454.

Circle 508 on inquiry card.



dBASE III: Relational DBM for 16-Bit Computers

Ashton-Tate has introduced dBASE III, a relational DBM (database manager) for 16-bit microcomputers. With dBASE III, you can enter, manipulate, and retrieve large volumes of data as well as develop custom applications programs to put that information to work. Its storage capabilities, limited only by your computer, can be as high as 2 billion records per file with 128 fields per database. As many as 10 database files can be simultaneously operated.

At the same time, Fox & Geller (604 Market St., Elmwood Park, NJ 07407) has announced that it is supplying Quickcode III, dUTIL III, and dGRAPH III versions of its dBASE enhancements. Quickcode is an applications generator that uses the dBASE programming language. dUTIL is a general utility program, and dGRAPH sorts, averages, and totals dBASE data and displays it graphically.

dBASE III provides fast sorting and indexing of stored data and color displays. Its user interface features a command assistance mode that guides novices through the most common areas of the database. Full on-line, context-sensitive help is available at the press of a key.

Written in C from the ground up, dBASE III uses the same English-like commands as its predecessor, dBASE II, with only minor modifications and enhancements for new functions and program changes. It also uses the dBASE programming language, which lets you develop your own applications programs. It's compatible with Framework and dBASE II. Miscellaneous features include variable-length text files of up to 4K bytes per entry, 4000 bytes per record (fixed length), 512K bytes per record (variable length), 15.9 digits of numerical precision, full-screen data entry and modification, and report and mailing-list generation.

dBASE III currently runs on the IBM PC, PC XT, and all IBM PC compatibles. Minimum system requirements are 256K bytes of RAM, dual 5¼-inch 360K-byte floppy-disk drives, a monochrome or color display, PC-DOS 2.0, and an 80-column printer. It will also work with a single floppy-disk and one fixed-disk drive. Available this month, it will list for $695. A take-home sampler tutorial can be obtained for $9.95. Owners of dBASE II wishing to upgrade to dBASE III should contact authorized dealers before July 31 for details on a preferential pricing program. Prices for the Fox & Geller programs had not been announced at press time. Contact Ashton-Tate, 10150 West Jefferson Blvd., Culver City, CA 90230, (213) 204-5570.

Circle 509 on inquiry card.

Multitasking Concurrent PC-DOS to Be Available in Third Quarter

Digital Research has announced that its long-awaited Concurrent PC-DOS will be shipped during the third quarter of this year. Pricing has been set at $295.

Of particular note to our corporate readers is Concurrent PC-DOS's ability to run as many as four PC-DOS or CP/M applications programs simultaneously, thereby making it a suitable productivity tool for team-working environments. It also runs most popular PC-DOS applications packages, such as Lotus 1-2-3, dBASE II, WordStar, MultiMate, and SuperCalc 3.

Concurrent PC-DOS works by presenting you with menus that outline a series of tasks to perform. The menu serves two functions. First, it guides the operator through all the system's resources and applications while tending to such control commands as copy, print, and delete files. The second function lets you create your own menus and compose special commands for custom-designed Help screens.

A communications capability lets you work on one application while the IBM PC receives information from an external database. Concurrent PC-DOS has a window capability that permits simultaneous monitoring of four applications. Windows can be positioned anywhere on screen, scrolled, or sized to display the important parts of the application. Information can be cut and pasted from applications by placing the window over the appropriate data.

Advanced productivity tools supplied include a print spooler, Rolodex, and a two-user function. The print spooler lets you queue up documents to be printed while other tasks are printing. Rolodex is a sorting and searching program for lists of names, addresses, and other pertinent data. The two-user function offers a remote dial-up link.

An IBM PC or PC-compatible system with 256K bytes of memory and two floppy-disk drives is required. For maximum efficiency, 512K bytes of memory and a hard disk are recommended. The $295 list price includes documentation. Contact Digital Research Inc., 160 Central Ave., Pacific Grove, CA 93950, (408) 649-3896.

Circle 510 on inquiry card.

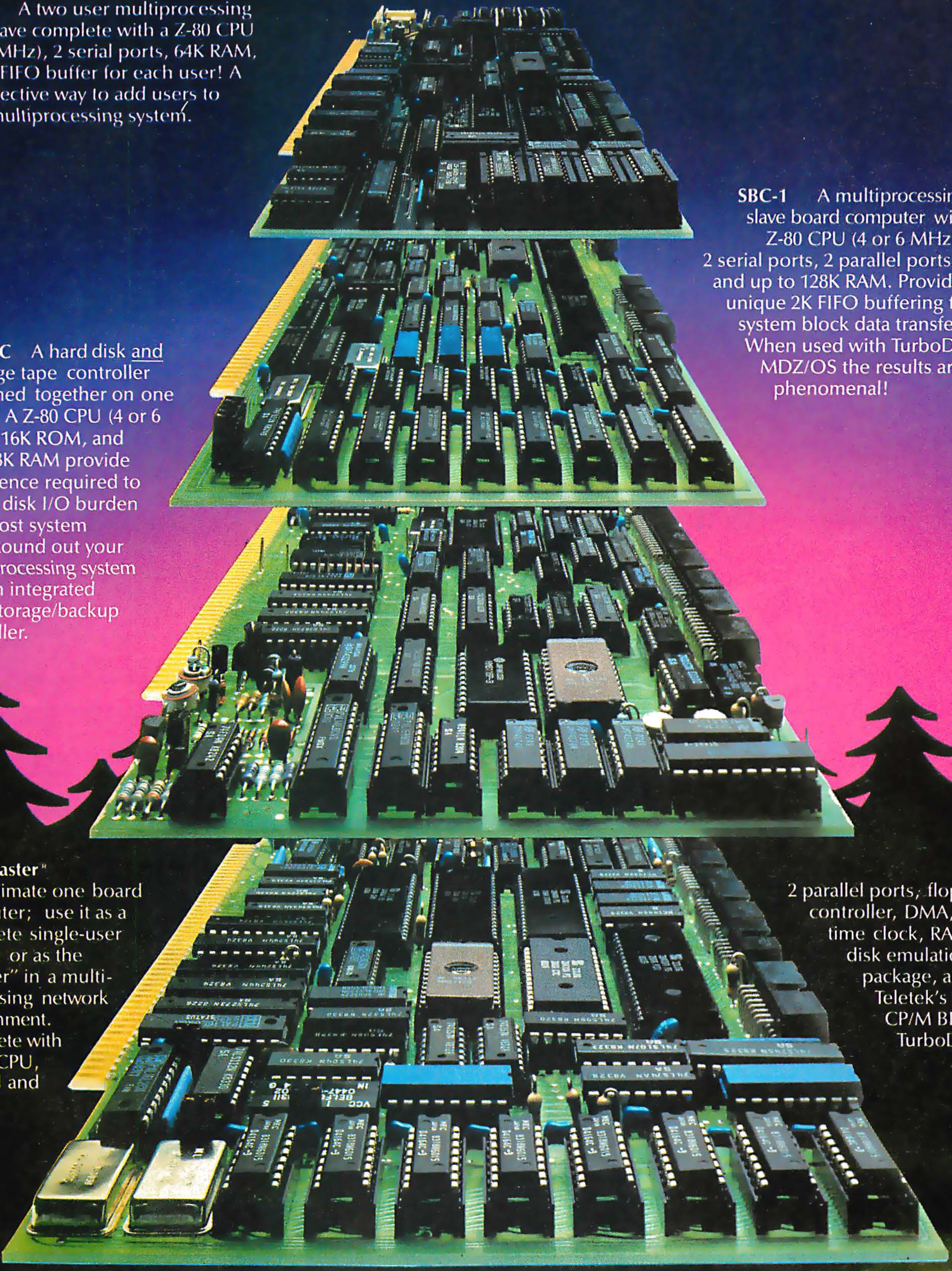
(continued on page 410)

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Conducted by Steve Ciarcia

POWER-LINE POLLUTION

Dear Steve,

I enjoyed reading "Keep Power-Line Pollution Out of Your Computer" in the December 1983 BYTE. A definite need exists for such protection devices to be utilized with computer equipment. However, when I contacted Radio Shack about the components, the only item available was the four-outlet power strip. The MOVs (metal-oxide varistors) have been back-ordered for months, and the EMI/RFI (electromagnetic interference/radio-frequency interference) filter is a discontinued item. Do you have any suggestions for an alternate EMI/RFI filter?

LEE E. ANDERSON
Rockville, MD

Radio Shack still sells the V130LA10A MOV transient protectors (part number 276-570), but it could not anticipate the demand caused by my article. In fact, I was surprised by the number of letters received on this subject. It's nice to know that many of you are interested in power-line protection.

I chose the Radio Shack MOVs because they were easily obtainable, but you can contact several other sources. The V130LA10A, which is manufactured by General Electric, should be available from a GE distributor or electronic parts supply house. Also, Panasonic and General Instrument manufacture similar units.

The Panasonic ERZ-C14DK201 is available as part P7063 from Digi-Key Corporation, Highway 32 South, POB 677, Thief River Falls, MN 56701, (800) 346-5144. The General Instrument part S14K130 is available from Active Electronics, POB 8000, Westborough, MA 01581, (800) 343-0874.

Several manufacturers produce power-line filters that are suitable for your applications. They include Corcom Inc., 1600 Winchester Rd., Libertyville, IL 60048, (312) 680-7400, type 5VB1 or 5VB3; Cornell-Dubilier Electronics, 150 Avenue L, Newark, NJ 07105, (201) 589-7500, type APF511L; Delta Electronic Industry USA, 1355 Yosemite Way, Hayward, CA 94545, (415) 785-5231, type 05DBAG5; and Potter Company, POB 337, Wesson, MS 39191, (601) 643-2215, type 600A5.

These filters are equivalent to Radio Shack part number 273-100. Write the manufacturers for additional information and the address of your nearest supplier.—Steve

Dear Steve,

Will a big transient lead to an MOV "suicide" while it is protecting my system? If so, how big? Also, how can I tell that the MOVs need to be replaced?

How much of my upstream wiring will be protected against transients by MOVs on a power strip with a line cord 3 feet long (as in figure 1a on page 43 of the December 1983 BYTE)?

Finally, I understand that an EMI/RFI line filter protects only downstream. Does EMI/RFI filtering affect upstream transient clamping by MOVs?

N. C. WEBB
Lincoln, MA

MOVs have an energy rating expressed in joules or watt-seconds, but the actual energy absorbed is a function of the applied transient waveform. Also, a device with a lower clamping voltage will absorb less energy. Therefore, it is difficult to give a specific failure value.

MOVs are rugged devices conservatively rated and exhibit a low failure rate when properly selected. Still, they do fail, and their failure characteristics should be considered. MOVs initially fail in a short-circuit mode when subjected to transients beyond their peak ratings. Short-circuit failures also occur when MOVs are operated at steady-state voltages in excess of their voltage ratings.

When a device short-circuits, it can demand large amounts of energy input, and failure occurs by rupturing of the package and expulsion of material. This miniexplosion can be minimized by a fuse in series with the MOV to open the circuit when such failure occurs. Locating the MOV away from other components will avoid damage from packaging material.

In answer to your second question, since the MOVs are in parallel across the AC line, they should, in theory, provide protection to any device connected to it. However, the AC wiring has inductance and capacitance and will present different impedances to various transients. Assumptions as to the effective length can be made, but it is safer to have the MOVs close to the device requiring protection.

Lastly, the EMI/RFI filters do not affect the upstream clamping ability of an MOV. Conversely, the EMI/RFI filters tend to reduce the transient voltage levels downstream of the line and make the MOVs work somewhat easier. The components in the filter are usually not damaged by transient voltages.—Steve

Dear Steve,

I was unable to find GE part V130LA10A at Radio Shack—sold out for many weeks!—and had to get V130LA20A units. Does the "10A" stand for 10 amperes (A) and the "20A" for 20 A? In terms of transient protection, what is the gain, or loss, from the use of V130LA20A units rather than the V130LA10A units?

ELBERT S. MALONEY
Pompano Beach, FL

The GE MOV-II varistors such as the V130LA10A described in my article use the following model number nomenclature:

V	*the GE MOV varistor*
130	*the applied RMS (root mean square) voltage*
LA	*product series (LA for radial leads)*
10	*pulse energy rating*
A	*clamping voltage*

The 130 volts (V) indicates that it would be suitable for a standard 117-V AC line and allow for an overvoltage of 10 percent. The pulse energy rating of 10 indicates that the MOV has a maximum allowable energy rating of 38 joules for a single noncomplex impulse of 10/1000 microsecond (μs). The clamping voltage is the peak terminal voltage measured with an applied 8/20-μs impulse current of 50 A.

The V130LA20A has a pulse energy rating of 70 joules and a clamping voltage of 340 V with a peak current of 100 A. It is an excellent substitute and will result in a higher safety factor.—Steve

Dear Steve,

Perhaps I'm paranoid, but I live on top of Little Mountain in the Great Smokies. This area is pretty high by Connecticut standards, and lightning strikes are a frequent occurrence. For example, I've lost three white pines to lightning in the past few years, and I've seen a 200-watt light bulb *explode* in my summer home when a surge came down the power line; fortunately, nothing else was turned on at the time. When I built a permanent home, I went all out on lightning protection. Here are a couple of hints you might find useful.

First, a careless reader of the "How Lightning Strikes" text box (December 1983, page 38) might get the impression that one rod is enough. I had a professional lightning rod installer do my home. He put a rod every six feet along all the ridge lines, tied them all together with cable, fastened that to all the other metal on the roof, and brought the cable down to three separate grounding rods. You should see the purple glow in the air during electrical storms. Something is definitely happening up there on the roof, but I haven't had a strike.

Second, my electrician was able to install a lightning arrester on the power-line side of my meter box. I don't know what's inside but am glad to have it there.

Since you live in Connecticut, I can see why you wrote, "Blackouts generally affect only a small number of utility customers...and generally last less than 10 seconds." It just ain't so here in the Great Smokies. I suspect many

(continued)

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others who live at the *end* of their power lines have learned it isn't true for them either. I've learned to be careful. I never use my computer during storms, and I back up frequently—even on cloudless days. But I'd like an uninterruptible power supply. The problem is, I don't know how to select a good one. For example, I'd like the AC to come from the (trickle-charged) battery all the time, because I've been told that even momentary glitches can mess up some computers.

If you'd write something on this topic, I will appreciate it. A Circuit Cellar design would give us something to have faith in.

CHARLES R. BLAIR SR.
Townsend, TN

You are indeed correct that more than one lightning rod is required for a roof or other large structure. The down line should be dressed away from the house to prevent any arc-over in the event of a strike, and multiple grounds are a good idea. I have seen installations where the soil itself was treated with salts to improve conductivity.

General Electric manufactures a device known as the Home Lightning Protector, which is designed to mount at the weatherhead or meter housing of the AC line. It uses a Thyrite element to clamp surges at about 650 V and should be installed by a licensed electrician. The device number is 9L15BC002, and it can be obtained from an electrical supply house. Another unit is the Square D Model J9200-10, and similar units are available from other manufacturers.

I have had many requests for an uninterruptible power supply and am considering an article for a low-cost unit. Watch for it.—Steve

Dear Steve,

I use a Universal Data Systems 103LP modem that is powered by the telephone line. When an electrical storm is in the vicinity, my connection to the computer has been lost several times shortly after lightning flashed several miles away. Once a nearby strike not only made me lose the computer connection, it also erased the memory in my LA34 DECwriter. Do power surges affect this kind of modem, and can I build a surge protector for my telephone line similar to the power-line protector you described in the December 1983 issue?

GERMAIN BOER
Nashville, TN

Power surges can affect any equipment and cause damages ranging from simple loss of memory to complete destruction. Solid-state devices are much more susceptible to transient voltage surges and noise. While the telephone lines use protection devices such as carbon gaps, gas tubes, and heat coils, solid-state circuitry is still vulnerable. The V130LA10A MOVs that were used for power-line protection can also protect the telephone lines. They are applied in the same manner as for power lines (line to line and from each line to ground), but check with your local telephone company before connecting any nonapproved components.—Steve

Dear Steve,

I'm a pretty fair amateur electrician. Would it be possible to wire in some suppression where the power lines enter the house and thus afford protection throughout? What would you use? Would high-surge lines (air-conditioner circuit, etc.) have to be isolated? How? It seems to me that wiring something into the circuit-breaker panel, if it's workable, is a lot more elegant, and likely to be cheaper, than scattering power strips around the house.

JOHN CARL BOWERS
Bronx, NY

Devices such as the GE Home Lightning Protector connect across the power line at the service entrance to reduce the amplitude of large transients and lightning surges. These are two-pole, three-wire units designed for 120/240-V single-phase service. They mount in a ½-inch knockout in the service entrance box or at the weatherhead. Available at an electrical supply house, they are in the $20 range. Because they clip at voltages higher than the MOVs described in my article, the MOVs should still be used.—Steve

BANK SWITCHING

Dear Steve,

In writing about the Fujitsu Micro 16s ("A Machine for All Processors: The Fujitsu Micro 16s," June 1983 BYTE, page 150), Wayne Clingingsmith says on page 156, "In slot 2 of the standard unit is an 8-bit Z80A microprocessor board. It operates at 4 MHz and has memory-bank-selection circuitry that enables it to address the full 24-bit (16-megabyte) address space of the Micro 16s." How does Fujitsu do that? What is bank-selection circuitry?

The manual accompanying my CompuPro CPU-Z says that an OUTput of C1, for example, to port FD will enable memory on page C1 and disable memory on all the other pages. I understand that, but I am completely terrified by the thought of even trying to write a routine callable from several pages with a RETurn to the proper page. How do you assign a 24-bit address to a LABEL in assembler code?

JACK H. HAYES
Maryville, TN

Yes, it is possible to address 16 megabytes of memory with an 8-bit Z80 processor. As you seem to suspect, however, it's not all available at the same time. Actually, on the S-100 machines that have 24 address lines, it's more usual to use the upper 8 address lines to select one of eight 64K-byte blocks for a maximum of only 512K bytes. This way, you can treat each line as a chip-select (block-select) line and wire the chip-select line on each board to a specific address line on the bus. A circuit to do this is given in the book Interfacing to S-100 (IEEE 696) Microcomputers *by Sol Libes and Mark Garetz (Osborne/McGraw-Hill). The bank address is then output to a port (apparently port FD on your CompuPro system) and used to latch the*

(continued)

appropriate bank-select line to an active state.

There are limitations on the addressability of programs and data in this extra memory, too. For example, you can't write routines that are directly callable from your main program if you switch 64K-byte blocks. It is much easier to handle the block switching if you switch only 32K or 48K bytes at a time and keep control of this with the lower 16K bytes that don't get switched. This can be made easier by using the PHANTOM line that is available on some S-100 systems to control a smaller block of memory.

If more memory is required, a more complicated bank-switching logic can be implemented to emulate the segmentation used in the 8086/8088 family of processors. This will allow addressing a full 16 megabytes in blocks as small as 256 bytes with 24 address lines.

A number of books discuss design of systems like this. I suggest you browse through the computer book section at a library or some of the larger book stores.—Steve

Foreign Character Generators

Dear Steve,

Do you know where I can find a foreign-language character generator for either an IBM PC or a Hewlett-Packard Model 16?

Yong Nanagara
Reading, PA

Several programs are available for the IBM PC that may serve your purpose. Character-generator programs that let you generate and save your own character sets for screen display include Lenitext from Duncan Atwell Computerized Technologies Inc., 1200 Salem Ave., Hillside, NJ 07205; Font Editor from Versa Computing Inc., 3541 Old Conejo Rd., #104, Newbury Park, CA 91320; and Graphic Character Editor from C & C Software, 54 Sonoma Ave., Goleta, CA 93117.

The following program, which was reviewed in the January 1984 PC *magazine, contains a large number of character sets that can be printed with an Epson or an IBM Graphic dot-matrix printer: Fancy Font from SoftCraft, 8726 Sepulveda #1641, Los Angeles, CA 90045.*

Word processors that have foreign-language character sets include Arabic-WP, Multilingual-WP, and Translator Aid System, all produced by Economic Insights, 416 Center St., Washington Grove, MD 20880.

I suggest you contact these companies or your local computer store for information about the capabilities of the programs.—Steve

Infrared Links

Dear Steve,

I have a few questions for you. Do you know of any units that can provide a good two-way RF link between a computer and a terminal? Are you doing any more work on infrared links?

Also, with more computers running on batteries these days, how about a circuit that can indicate not only low or high voltages but also the presence of spikes and dropouts that may have caused a system error or crash?

David Smith
Milford, IA

I haven't heard of any low-cost RF data-communications equipment that would be satisfactory for a terminal-to-computer link, but one similar application is the Atari wireless joystick interface. The infrared or optical links seem to be getting more attention lately, with Fujitsu developing an infrared modem and a hand-held computer from Canon with an infrared printer interface in the works. And, of course, the IBM PCjr has an optical keyboard link.

Infrared light or visible light using LEDs and photo diodes or transistors seem like optimum media for this application because they avoid the potential for all sorts of RF interference problems that can arise with radio links. For-

(continued)

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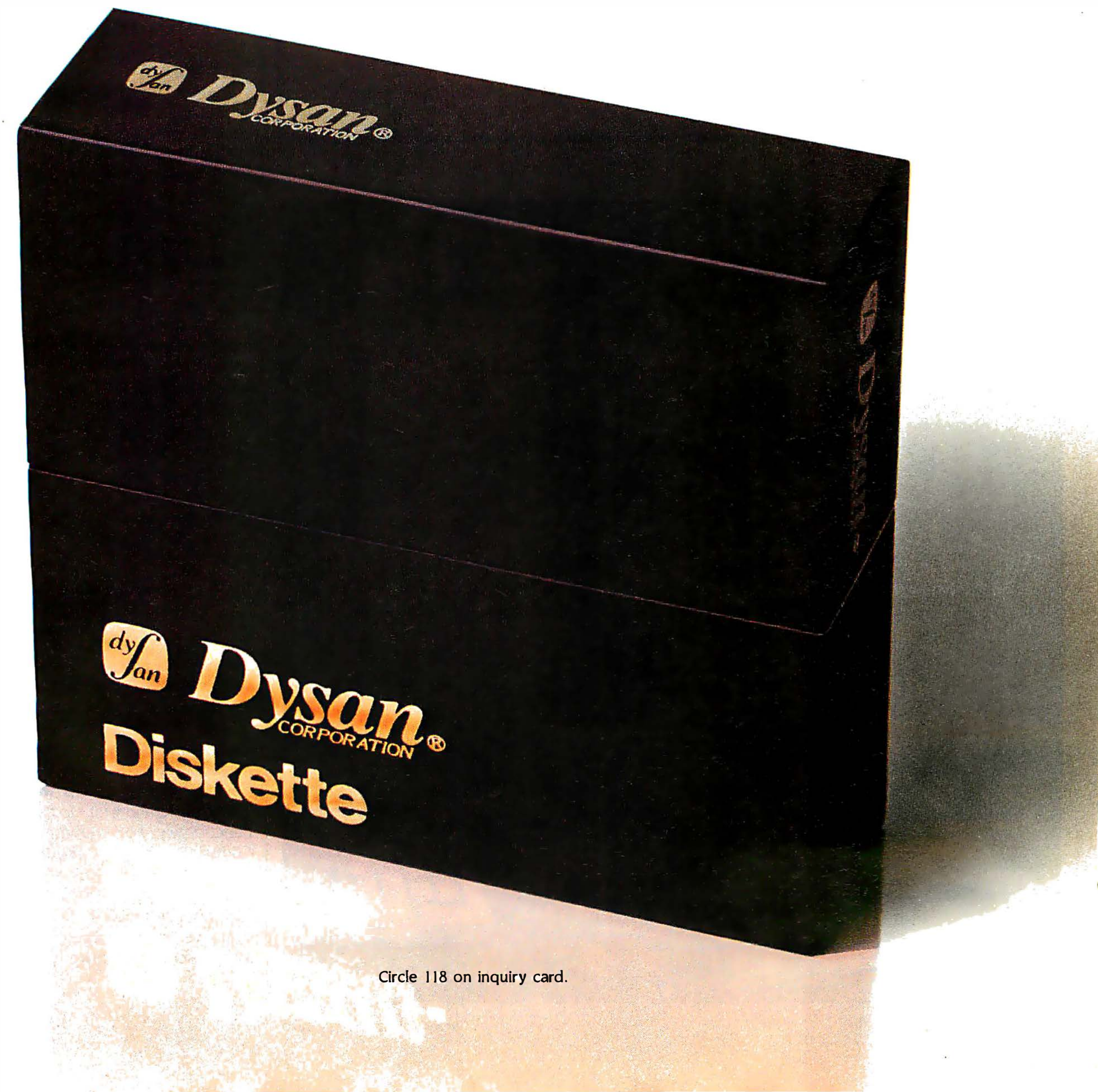
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ASK BYTE

rest Mims III has written several articles in Computers and Electronics *(formerly* Popular Electronics*) on data communications using LEDs and photo transistors. See the October and November 1983 issues for two articles of particular interest.*

It is not usual to find voltage transients in the power circuitry of battery-operated equipment unless they are caused by faulty wiring, such as loose connections, bad solder joints, and the like. Batteries are sometimes used as filters in low-voltage equipment because of their extremely high capacitance, so we should not find crashes caused by any battery problems except low voltage. If you have been having problems of this type, you may have a problem with bad connections or insufficient decoupling between circuit elements. It is common practice to use decoupling capacitors of 0.01 to 0.1 microfarad from the V+ terminal to common ground at each IC to prevent noise generation on the supply bus.—Steve

MS-DOS VERSUS PC-DOS

Dear Steve,

I have a Canon AS-100 that runs MS-DOS programs. I use "Copy F: to Copy A:" to bring an IBM PC program over to the Canon. A good many times it works, but a lot of times I experience total failure. Isn't PC-DOS different from MS-DOS? I saw a program that lets you execute a PC-DOS program through a CP/M-86 environment. Are the CP/M-86 calls similar to PC-DOS calls? Can CP/M-86 address certain parts of the BIOS (basic input/output system) ROM (read-only memory) that regular MS-DOS can't address?

Second, I have a lot of programs in BASIC and recognize that UNIX will be the dominant operating system of the future. How can I transport the BASIC programs into a UNIX environment? Are there emulators that recognize BASIC and convert it into the C language?

Finally, can the Micro D-Cam (September and October 1983 BYTE) be used to read typewritten invoices and automatically enter data into a computer, thus eliminating the use of a keyboard?

ARTHUR BRANDMEIN
Flushing, NY

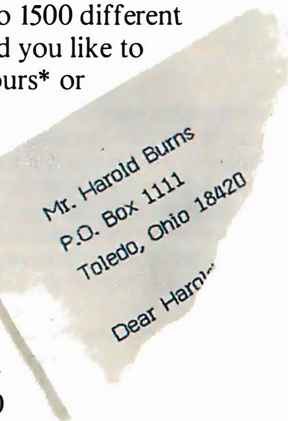
Your questions regarding software transfer between the IBM and Canon computers relate more to differences in their BIOS structures than to differences in their operating systems per se. PC-DOS and MS-DOS are somewhat different internally. MS-DOS is designed to be installed in many types of machines with different I/O devices, while PC-DOS was written for one specific machine with most of the BIOS in ROM. Functionally, however, the two are the same. Software written for the IBM PC has a good chance of running on some "compatible" 8088/8086 machines if it does not bypass the DOS I/O calls, use the IBM's ROM BIOS functions or, worse yet, output directly to port addresses or access screen memory directly.

(continued)

THE BUFFER DID IT.

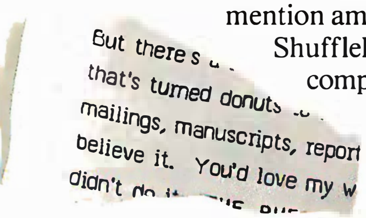
Who Stole The 1500 Letters From The Computer?

Let's just say you've got to send a letter to 1500 different people. Would you like to spend 22.5 hours* or 60 seconds of computer time?



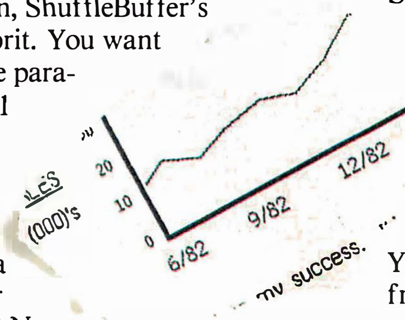
With a garden-variety buffer, the computer has to mix, merge and send 1500 addresses and 1500 letters to the buffer. Trouble is, most buffers only store about 32 letters. So after 32 letters, the computer's down until the printer's done. Altogether, you're talking 22.5 hours.

In the case of our new (not to mention amazing) ShuffleBuffer, computer time is 60 seconds flat. Just give ShuffleBuffer one form letter and your address list, and it takes care of the mixing, the merging, and the printing. But that's not all ShuffleBuffer's stolen from the computer. Oh, no.



Who Changed and Rearranged The Facts?

Again, ShuffleBuffer's the culprit. You want to move paragraph #1 down where #3 is? Want to add a chart or picture? No problem. No mystery, either. Any buffer can give you FIFO, basic first-in, first-out printing. And some buffers offer By-Pass; the ability to interrupt long jobs for short ones. But only ShuffleBuffer has what we call Random Access Printing — the brains to move stored information around on its way to the printer. Something only a computer could do before. Comes in especially handy if you do lots of printing. Or lengthy manuscripts. Or voluminous green and white spread sheets. And by the way, ShuffleBuffer does store up to 128K of information and gives you a By-Pass mode, too.



And Who Spilled The Beans 239 Times?

Most buffers can't tell the printer to duplicate. If they can, they only offer a start/stop switch, which means you're the one who has to count to 239. Turn your back on your buffer, and your printer might shoot out a room full of copies. ShuffleBuffer, however, *does* control quantity. Tell it the amount, and it counts the copies. By itself.

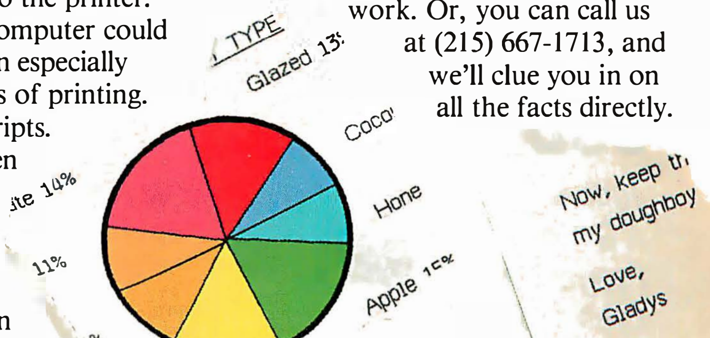
So, What's The Catch?

There isn't any. Sleuth around. You won't find another buffer that's as slick a character as this one. You also won't find one that's friendly with any parallel or serial computer/printer combination. This is the world's only universal buffer.

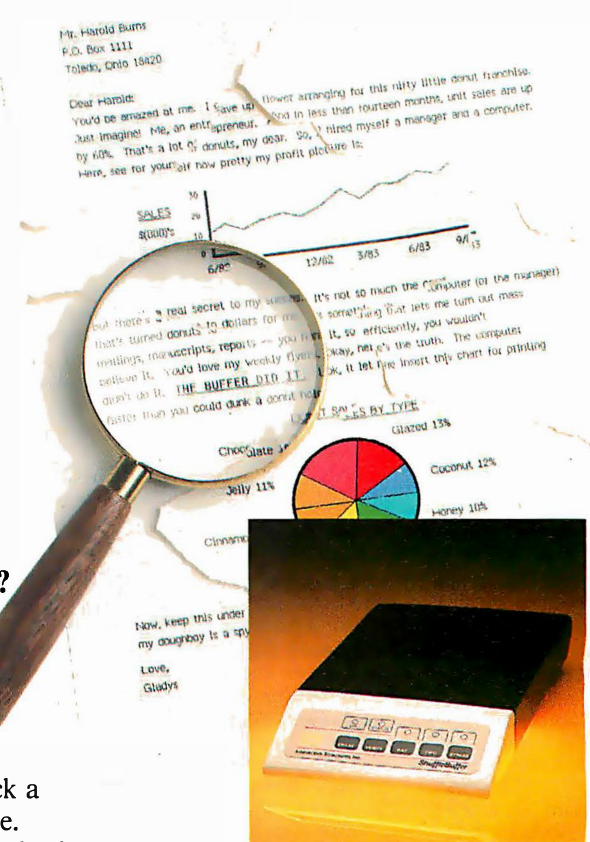
With a brain.

Who Wants You To Catch A ShuffleBuffer In Action?

You guessed it. We do. Just go to your local computer dealer and ask him to show you a ShuffleBuffer at work. Or, you can call us at (215) 667-1713, and we'll clue you in on all the facts directly.



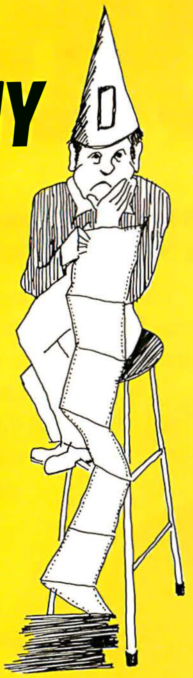
* Based on an average 4000 character letter & 128K buffer.



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Most of the PC-DOS calls perform the same functions as the corresponding CP/M-86 BDOS calls. MS-DOS was originally written to provide as much upward compatibility with CP/M-80 as possible. This was done to simplify the translation of existing software, but MS-DOS, PC-DOS, and CP/M-86 all have additional functions, in some of which we find considerable differences between MS-DOS/PC-DOS and CP/M-86. Another difference is that PC-DOS accesses DOS calls through INT 33, while CP/M-86 uses INT 244, and generally uses different interrupt numbers for most other BIOS functions as well. In other words, while PC-DOS uses all the IBM ROM BIOS functions, CP/M-86 brings its own BIOS in.

The answer to your next question involves some speculation. First, UNIX or a similar operating system may well become popular for larger business microcomputers, but it isn't universally accepted that it will take over the personal computer field. Second, if UNIX does become popular for personal computers, it seems a fair bet that Microsoft and Digital Research will provide compatible BASIC interpreters and compilers. Therefore, you probably shouldn't be too concerned about transporting your BASIC programs. Also, you should know that while C was originally written in the UNIX environment, it is now available for MS-DOS and CP/M-86.

Lastly, yes, the Micro-D Cam can, in principle, be used to enter typewritten data directly into the computer. The picture is stored as a bit-mapped image much the same as any monochrome graphics display, so a picture could be transferred into a block of memory in the computer and processed to translate the bit patterns into letters and numbers. In practice, however, this turns out to be fairly difficult to do with a high degree of reliability for several reasons having to do with varying sizes, locations, and orientation of the character images. It would be a fun programming project though.—Steve

MEMORY ACCESS TIME

Dear Steve,

My query involves processor speed versus memory access time. The higher the processor clock rate, the more instructions that can be executed in a given time. This is of no avail, however, if the processor has to wait for slow memory. Without any instruction buffering between the fetching and execution of an instruction, the simple equation would seem to hold, for no wait states:

memory access time = 1/instruction execution rate

The instruction execution rate depends on the processor clock speed and may be one instruction per clock cycle. Nowadays, it is not that simple with pipelined architectures, instruction buffering, and memory management.

The problem is that, with various claims and counterclaims by different manufacturers, it becomes difficult to determine what memory access time is required for a particular processor to operate at a particular clock rate. Would you be able to determine the access time required for the more popular processors to operate with no wait states at a set clock rate?

PAUL SHIELDS
Dampier, Western Australia

Even though it might seem that the required memory access time for the simpler processors would be simply 1/instruction rate, it is really not that simple. Only in some 4-bit processors do we find instructions that execute in one clock cycle. For example, the shortest instructions vary from two cycles in the 6500, 6800, and 8086 series processors to four cycles in the Z80 and 8080 families.

A look at some timing diagrams for memory chips and various processors will show that actual read or write time can be as little as about one-and-a-half clock cycles, but the timing must allow for the data coming out from memory to become stable and for the processor to see the data long enough for a stable reading. The times required for this vary between different models of the same processor as well as between different types. The time for data to be valid at the memory output also varies. Thus, the only safe way to determine the access time is to obtain data on the processors and memory chips you are interested in and work out the timing. This information can be obtained from data sheets and application notes that are sometimes available from the manufacturers or from some of the advertisers in BYTE.

Two good sources for information on most of the available microprocessors are the Osborne Four and Eight Bit Microprocessor Handbook *and the* Osborne Sixteen-Bit Microprocessor Handbook *by Adam Osborne (Osborne/McGraw-Hill). A number of other good books deal in depth with specific processor families. You might read these for background if you need it.*—Steve

UPGRADING S-100 STANDARDS

Dear Steve,

I have an IMSAI 8080 that I would like to upgrade to 256K or 512K bytes of RAM. I'm hoping that you can help me.

Can I replace my Z80 board with a Cromemco Z80/68000 dual-processor board and use 256K- or 512K-byte memory boards on my system? What about CompuPro 8085/8088 and 8086/8087, 68000, and I/O and memory boards? Is it possible to use 16-bit boards from other manufacturers?

Thank you for your help.

AKBAR FASSIHY LANROODI
Tehran, Iran

The advantage of an S-100 system is that it is very versatile and can be upgraded easily. Now that the IEEE has established an S-100 bus standard, boards from one manufacturer should

(continued)

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work with boards from any other manufacturer that uses the standard. It is now possible, for example, to purchase a Cromemco processor, an SD Systems RAM board, and a CompuPro floppy-disk controller and expect them to work properly together.

There are some problems in upgrading an old system that may not have IEEE-696-compatible boards because some old S-100 boards used signals that do not agree with the new standard. For example, new processor and memory boards use lines 58 and 60 to determine if a 16-bit or an 8-bit memory transfer will take place on the bus. Older boards that do not have these signals may not work properly with new IEEE-696 boards. If you have some of these older boards and want to use them with a new system, it is possible to modify them to meet the new standard. A good reference book on this subject is Interfacing to S-100 (IEEE 696) Microcomputers *by Sol Libes and Mark Garetz (Osborne/McGraw-Hill).*

Before upgrading your system, it would be beneficial to review the newer products from the many companies now manufacturing S-100 boards so that an optimum system can be selected. The Priority One Electronics engineering selection guide is a good source of this type of information because it covers a wide selection of S-100 products from a variety of manufacturers. This selection guide can be obtained from Priority One Electronics, 9161 Deering Ave., Chatsworth, CA 91311.

Another source of reference material for the S-100 bus is Microsystems *magazine, which covers the S-100 bus and CP/M subjects. The September 1983 issue should be of special interest to you because it contains an article on converting an IMSAI system to use the CompuPro 8085/8088 dual-processor board. The same issue also has an article on running N*DOS as a COM file under CP/M with an N*-to-CP/M file-transfer facility. Volumes of* Microsystems *magazine can be obtained from Microsystems, CN 1987, Morristown, NJ 07960.*
—Steve

MICROPROCESSORS

Dear Steve,

Is there a single publication that contains a listing of the computers that use a specific type of microprocessor? If not, could you list several microcomputers that use the 68000 chip?

NADDER SARSHAD
Edison, NJ

The October 1983 Radio Electronics *featured a comprehensive computer buying guide, listing computers by price range. The tables of specifications showed the microprocessor, operating system, and specific features of each unit. Back issues of the magazine may be obtained from Gernsback Publications Inc., 200 Park Ave. South, New York, NY 10003.*

Several microcomputers utilizing the Motorola M68000 chip include Apple's Lisa and Macintosh, Hewlett-Packard's HP-200, Radio Shack's TRS-80 Model 16, the Sage II, and Sord's Model M68.—Steve ■

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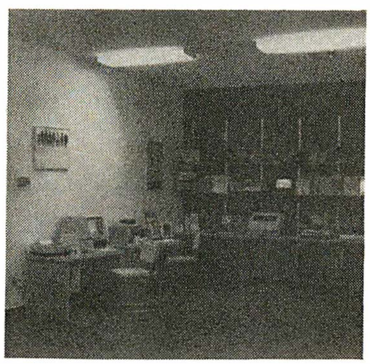
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The MSX Interest Group (MIG) keeps members up to date with the latest developments on the MSX graphics standard, which is currently supported by several American and Japanese computer manufacturers. A newsletter is produced each month. Annual dues are $15. Write to MSX Interest Group, Room 1009, 350 Fifth Ave., New York, NY 10011.

● CANYON DE CHELLY—FOUR CORNERS USERS GROUP. The Four Corners Users Group is primarily made up of Commodore users, but users of other computers are encouraged to join. They meet bimonthly at one of the Chinle, Arizona, public schools. All group meetings serve users in the Four Corners area and the Central Navajo Indian Reservation. The club is currently seeking public-domain bulletin-board system (BBS) software for CBM 8032 or Commodore-64 computers with a 2031-, 8050-, or 4040-based disk. For information, send a self-addressed, stamped envelope to Canyon de Chelly—Four Corners Users Group, Calumet Consulting, Box 1945, Chinle, AZ 86503, (602) 674-3421.

● CHAOS ON BBS
The BBS of the Capitol Hill Atari Owners' Society (CHAOS) in Lansing, Michigan, is open from 5 p.m. to 8 a.m. at (517) 373-6788. The club maintains a public-domain software library, produces a nonprofit newsletter, meets monthly, and houses several special-interest groups. Annual dues are $12. For details or the library's listing, send a self-addressed, stamped envelope to the Treasurer, CHAOS, POB 16132, Lansing, MI 48901.

● LISA NEWSLETTER NOW INCORPORATES THE MAC. *Semaphore Signal*, a newsletter about Apple's Lisa, has expanded to include coverage of the Macintosh computer. The newsletter is created, edited, and printed using a Lisa. Any users in the United States who submit the serial number of their Lisa or Macintosh can qualify for a free subscription. Other readers can subscribe for $10 (10 issues); $20 overseas. Contact *Semaphore Signal*, 207 Granada Dr., Aptos, CA 95003, (408) 688-9200.

● MILWAUKEE'S BLINKIN CURSOR. *Blinkin Cursor* is the newsletter of the IBM Personal Computer Users Group, an assembly of Milwaukee, Wisconsin, area computer users interested in the IBM and compatible machines. The twice-monthly meetings feature hardware and software demonstrations and question-and-answer sessions for beginners. The newsletter runs a list of current members. For further details, contact *Blinkin Cursor*, POB 305, Elm Grove, WI 53122.

● MAC SIG IN APPLE PI
The Washington Apple Pi (WAP) has formed a special-interest group for owners of the Macintosh computer. The group will hold tutorials, distribute software from its public-domain library, and publish articles about the Mac in its monthly newsletter. In addition, 75 qualified volunteers man a hot line to handle questions from members on specific programs, peripherals, and programming languages. Membership is $25. For office hours, next-meeting details, and general information, contact the Washington Apple Pi, Suite 201, 8227 Woodmont Ave., Bethesda, MD 20814, (301) 654-8060.

● CBR ON LINE
The *Computer Book Review (CBR)*, produced bimonthly, runs more than 100 annotated reviews of recently published computer books under such categories as applications, business, communications, history, software, juvenile, introductions, references, languages, and specific brands of computers. An electronic version of *CBR*, on line with NewsNet, is issued biweekly. *CBR* also covers trade news, book ratings, and graphics. Subscription rates are $15 annually; a foreign subscription is $25. For information on subscriptions via NewsNet call (800) 345-1301. To subscribe to the hard copy, contact the *Computer Book Review*, 735 Ekekela Place, Honolulu, HI 96817.

● MEDICAL, COMMERCIAL, AND INDUSTRIAL MUMPS. One language that meets the requirements of the American National Standards Institute (ANSI) is MUMPS, or the Massachusetts General Hospital Utility Multi-Programming System. This programming language doubles as a database-management system with applications in more than 4000 medical, commercial, and industrial installations around the world. Its user group contains almost 1000 members. In addition to producing a quarterly newsletter, the club sponsors seminars and holds annual conferences for programmers and nonprogrammers interested in furthering their knowledge of MUMPS. For membership details, contact the MUMPS Users Group, Suite 308, 4321 Hartwick Rd., College Park, MD 20740, (301) 779-6555.

● THE MAC IN BCS
The newest special-interest group to branch from the Boston Computer Society (BCS) is the Macintosh Users Group. Novice and technical people constitute the audience that meets each month to witness demonstrations, presentations, and discussions about peripherals, software, and uses of the Macintosh. Call Jack Hodgson for meeting locations and further details at (617) 354-7899, or contact the Boston Computer Society, Macintosh Users Group, One Center Plaza, Boston, MA 02108, (617) 367-8080.

● TEXAS HAS HEART
The Heart of Texas (HOT) TRS-80 Club meets at 7 p.m. each month in Waco, Texas, to discuss computer languages, peripherals, operating systems, and applications for all models of Radio Shack TRS-80 computers including, I, II, III, 4, 12, 16, 100, Color Computer, Micro CoCo, and the Pocket Computer. Membership dues are $10 and include a subscription to the monthly newsletter and voting privileges; an associate membership of $6 entitles you to receive the newsletter only. For information, contact HOT TRS-80 Club, POB 1923, Waco, TX 76703.

● COAST-TO-COAST MS-DOS. Oriented toward users of MS-DOS-based computers, SIG-86 is an international 8086 MS-DOS users group that produces newsletters and public-domain software, runs a bulletin-board system, and maintains a software library. The 300-bps (bit-per-second) BBS can be reached at (617) 842-1435; the 1200-bps BBS is (617) 842-1712. Both are open from 11 p.m. to 6 p.m. Eastern time. Membership is $18 a year. For details, contact Joseph Boykin, 47-4 Sheridan Dr., Shrewsbury, MA 01545, (617) 845-1074, or Frank Warren, 25190 Cypress Ave. #213, Hayward, CA 94544, (415) 785-7499.

● ITALIAN COMPUTERISTS RALLY. Members of the Italian Society of Clinical Biochemistry work on the applications of personal computers to the clinical laboratory. The newsletter, Bio-

(continued)

CLUBS & NEWSLETTERS is a forum for letting BYTE readers know what is happening in the microcomputing community. Emphasis will be given to electronic bulletin-board services, club-sponsored classes, community-help projects, field trips, and other activities outside of routine meetings. Of course, we will continue to list new clubs, their addresses and contact persons, and other information of interest. To list events on schedule, we must receive your information at least four months in advance. Send information to BYTE, Clubs & Newsletters, POB 372, Hancock, NH 03449.

chimica Clinica Notiziario SIBioC, runs book reviews and other items of interest to its 3000-reader circulation. For details, contact Società Italiana di Biochimica Clinica, Sede e Redazione: via Keplero, 10-20124 Milan, Italy.

● *CADD*, A NEWSLETTER FOR EDUCATORS. *CADD*, a monthly newsletter, is designed to provide educators with information, articles, and tips for teaching computer-aided design and drafting more effectively. One section in the newsletter, called "CADD Without a System," gives an instructor material and advice for helping the student develop qualities the computer industry seeks. For a free issue, write to *CADD*, POB 906028, Tulsa, OK 74112, (918) 832-7124.

● AND FORTH 'TO CANADA. The Southern Ontario Chapter of the FORTH Interest Group meets periodically and sponsors conferences that include presentations, business meetings, and discussions. For details about the group, contact Dr. N. Solntseff, Unit for Computer Science, McMaster University, Hamilton, Ontario L8S 4K1, Canada, (416) 525-9140, ext. 2065.

● FOR CHAMELEONS AROUND THE WORLD. The most frequently asked questions directed at Seequa's technicians will be answered in a monthly publication produced by the International Chameleon User Group (ICUG), which is backed by Seequa. It features a listing of new software for the Chameleon and references to public-domain software for MS-DOS, CP/M-86, and CP/M-80. Questions can be sent along with the $18 annual membership fee to Joe Verzino, ICUG, POB 265, Dewitt, NY 13214, (315) 446-2763.

● SAGE COMMUNICATION LINK. The purpose of the Sage Users Group is to share information and provide an environment to develop members' proficiency and knowledge of microcomputing. The group holds general meetings for an information exchange; sponsors a bulletin-board/database system; maintains software and technical libraries; and updates information about the group's current events. It also produces a newsletter to enhance the group's communication links. For details, contact Randy Scott, Sage Computer, 4905 Energy Way, Reno, NV 89502, (702) 322-6868.

● WORLD TELECOMMUNICATIONS NEWS. *International Networks* is a monthly newsletter covering the technology and policy of world telecommunications. It analyzes significant security questions confronting the future of electronic mail and database networks. An annual subscription is $375. Write to *International Networks*, POB 187, Moulton Hill Rd., Monson, MA 01057, (413) 267-5171.

● COLORFUL MEETINGS. The Alachua Color Computer Users Group meets at 7 p.m. on the second Tuesday of each month at the Operations Center located behind the Kelly Power Plant in Gainesville, Florida. Interested persons can contact Al Kirk, 4617 Southeast 2nd Place, Gainesville, FL 32601, (904) 377-6285, or George McDonald, Route 2, POB 530, Alachua, FL 32615, (904) 462-5392.

● HUDSON VALLEY COMPUTERISTS. The Hudson Valley Personal Computing Club is a nonprofit organization that promotes interest in public-domain software available for the IBM Personal Computer. The club is a forum for information sharing, personal computer education, computer literacy, and user support. Monthly meetings are held at Ulster County Community College, Stone Ridge Campus, Stone Ridge, New York. Contact the Hudson Valley Personal Computing Club, H.V.M. Box 6057, Kingston, NY 12401.

● LOCAL GOVERNMENT APPLICATIONS. Local governments, private companies, and consultants that are interested in the local-government/microcomputer market can request a complimentary copy of a monthly newsletter, *Government Microcomputer Letter*. It focuses on news and software and hardware applications. City and county policies on the use of microcomputers are also covered. For subscription details or a free copy, write to *Government Microcomputer Letter*, POB 16645, Tampa, FL 33687. ■

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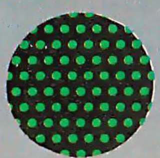
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ALGORITHMS
Robert Sedgewick, Addison-Wesley, Reading, MA: 1983, 550 pages, $30.95

FORTH FUNDAMENTALS
Volume 1, C. Kevin McCabe, dilithium Press, Beaverton, OR: 1983, 248 pages, $16.95

THE UNIX OPERATING SYSTEM
Kaare Christian, John Wiley and Sons, New York: 1983, 318 pages, $26.95

ARTIFICIAL INTELLIGENCE APPLICATIONS FOR BUSINESS
Walter Reitman, ed., Ablex Publishing, Norwood, NJ: 1984, 343 pages, $37.50

ALGORITHMS
Reviewed by Michael O'Neill

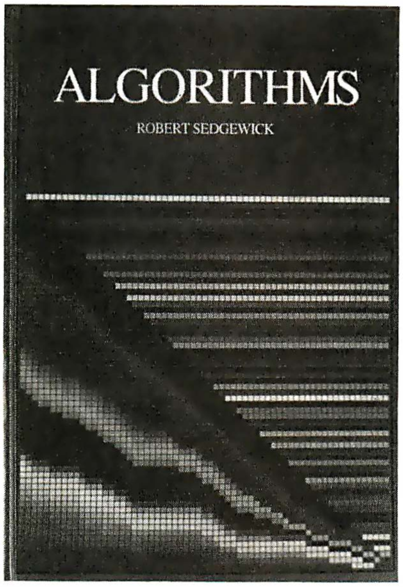
A while ago I read a summary by Robert Sedgewick of his doctoral dissertation on the fastest general-purpose sorting routine known, "Implementing Quicksort Programs," in *Communications of the Association for Computing Machinery* (volume 21, number 10, October 1978, page 847). I was impressed that the author did not deal only with the abstract details of the algorithm, but that he also covered the concrete aspects of its implementation. Furthermore, the tricks, trade-offs, and fine points he presented were general enough to be useful in most programming environments. And the writing style was clear and concise.

So when *Algorithms* was published, I was curious to see if the author would keep up the good work. I found that this book is as impressive as the aforementioned summary.

Algorithm Conversion

Sedgewick's stated goal is to teach "... a large number of the most important algorithms used on computers today well enough to be able to use and appreciate them."

The key phrases in the above quote are "large number" and "use." Professor Sedgewick deals with a staggering



number of algorithms. The book treats a wider range of subjects than any other single work I have seen. The seven major sections are: Mathematical Algorithms, Sorting, Searching, String Processing, Geometric Algorithms, Graph Algorithms, and Advanced Topics. The book covers a number of topics not usually dealt with by introductory texts: curve fitting, integration, parsing (language translation), cryptology, linear programming, and the fast Fourier transform. And these are intended to be used (and useful). The author tries to give the reader the knowledge needed to convert a given algorithm into a working program, and he provides basic information about how fast the program can be expected to run.

Limitations

The ambitious scope of the book implies that some trade-offs had to be made. The author usually only presents the basic form of each algorithm as a fully written-out program; he discusses fine points, tricks, and useful modifications but leaves their detailed implementation to the reader. He keeps theoretical discussion to a minimum. And while there is some introductory material on how to compute running times, he generally confines theoretical considerations to semi-intuitive treatments of running time and correctness questions.

Even with these limitations, the author has tried to pack a lot of information into 550 pages. Professor Sedgewick is in the unenviable position of making his exposition coherent and comprehensible without wasting words. The chapters are short; Quicksort is covered in 11 pages; parsing in 13. Thus, *Algorithms* is densely written. Information content is high, repetition is low, and there is ample cross-referencing. While there are some chapters on numerical algorithms that are rough going, I think the author has succeeded in making *Algorithms* work within these constraints.

A few warnings are in order, however. Because many of the implementation details are left to the reader and because the book is somewhat dense, it is neither a cookbook nor a reference work. The style also precludes skimming and diving into the text at random.

My only major criticism of *Algorithms* is a lack of coordinated references. The author gives only 5 or 10 references for each major section of the book, without indicating which one refers to the further information you may seek on a given subject. More extensive referencing (including references in the text) would add little to the length of the book but would make it possible to locate further information about specific algorithms.

Prerequisites

This book is not for beginners; a reader should have moderate programming experience and, I feel, should already have some basic knowledge of data structures. A more detailed list of what the prospective reader should know may be found on page 3 of the book itself.

By keeping theoretical detail to a minimum, by presenting a unified treatment

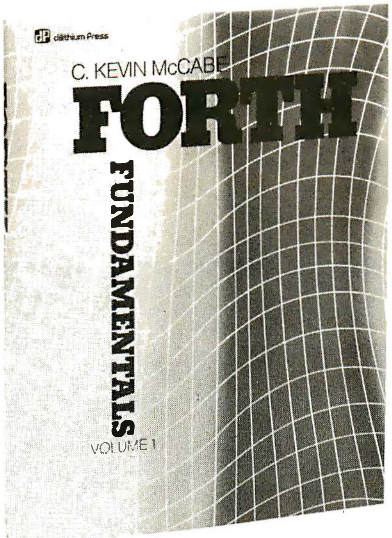
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of a wide variety of algorithms, and by treating implementation details with sufficient generality, Robert Sedgewick has written a work that will be useful to many practical programmers.

FORTH FUNDAMENTALS - VOLUME I
Reviewed by E. Francis Avila

Until the introduction of C. Kevin McCabe's *FORTH Fundamentals-Volume I*, textbook-quality FORTH programming books that were both well written and logically organized were in short supply.

McCabe's treatise has been sorely needed for many years. (FORTH was created by Charles Moore almost 15 years ago.) However, this book is not for those with little programming experience. For the novice programmer, I would still recommend the perennial mainstay, Leo Brodie's *Starting FORTH* (see review in September 1983 BYTE, page 494). But for the seasoned pro-



grammer looking for a professionally written dissertation of FORTH's operation, McCabe's book is indispensable.

IMPROVING THE IMAGE

The author treats his subject matter in much the same style that college texts cover material: technical, calculating, and concise. A book of this kind is needed if FORTH is to proceed beyond a fanatic's realm (a frequent stigma assigned to FORTH programmers) and be taken seriously in the world of professional programming. But because of an absence of professionally written texts on FORTH to date, many college computer-science departments have shunned teaching this versatile language. While McCabe's book is not intended as a college text, it is a beginning.

McCabe writes with an authority and assurance that can only come from an intimate knowledge of the subject. In contrast, it could be said that Leo Brodie never fully understood the language's intricacies and subtleties. This is not to deny that Mr. Brodie was the first to pen a readable book on FORTH; instead it is to acknowledge that his enterprise was a beginning point of

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FORTH books and succeeding works should improve upon this early text. McCabe accomplishes that task.

A Lot to Offer

The language FORTH is made up of words contained in a vocabulary. These words represent specific programming operations and functions. The language is supplied with a set of core vocabulary words with which the programmer begins. As a programmer becomes proficient with the language, he normally develops extensions of the core to perform new and complex tasks. The purpose of a FORTH text is to examine and describe the function and use of each word. McCabe's job, therefore, is to describe each core word in complete detail, and he manages to do this admirably.

Organization is the Key

The author's greatest strengths are his organization of the subject matter, his straightforward writing style, and his knowledge of the language. Organization is an important point since FORTH is based on a word vocabulary. Each new word introduced generally builds upon previous words. McCabe provides a logical progression of the FORTH vocabulary, emphasizing important words with exercises for the reader to try. In general, his exercises worked on my system using a FORTH-79 language. As each new word is introduced in the book, McCabe lets the reader know immediately on which standard the word is based. This is a real plus. A criticism of Brodie's *Starting FORTH* was that his book was based on PolyFORTH, a unique version of FORTH not in keeping with the proposed standards (more on that later); consequently, not all exercises would work properly, if at all. Several of Brodie's FORTH words are not available in the two most popular versions of the language, FIG-FORTH and FORTH-79.

Difficulty with Detail

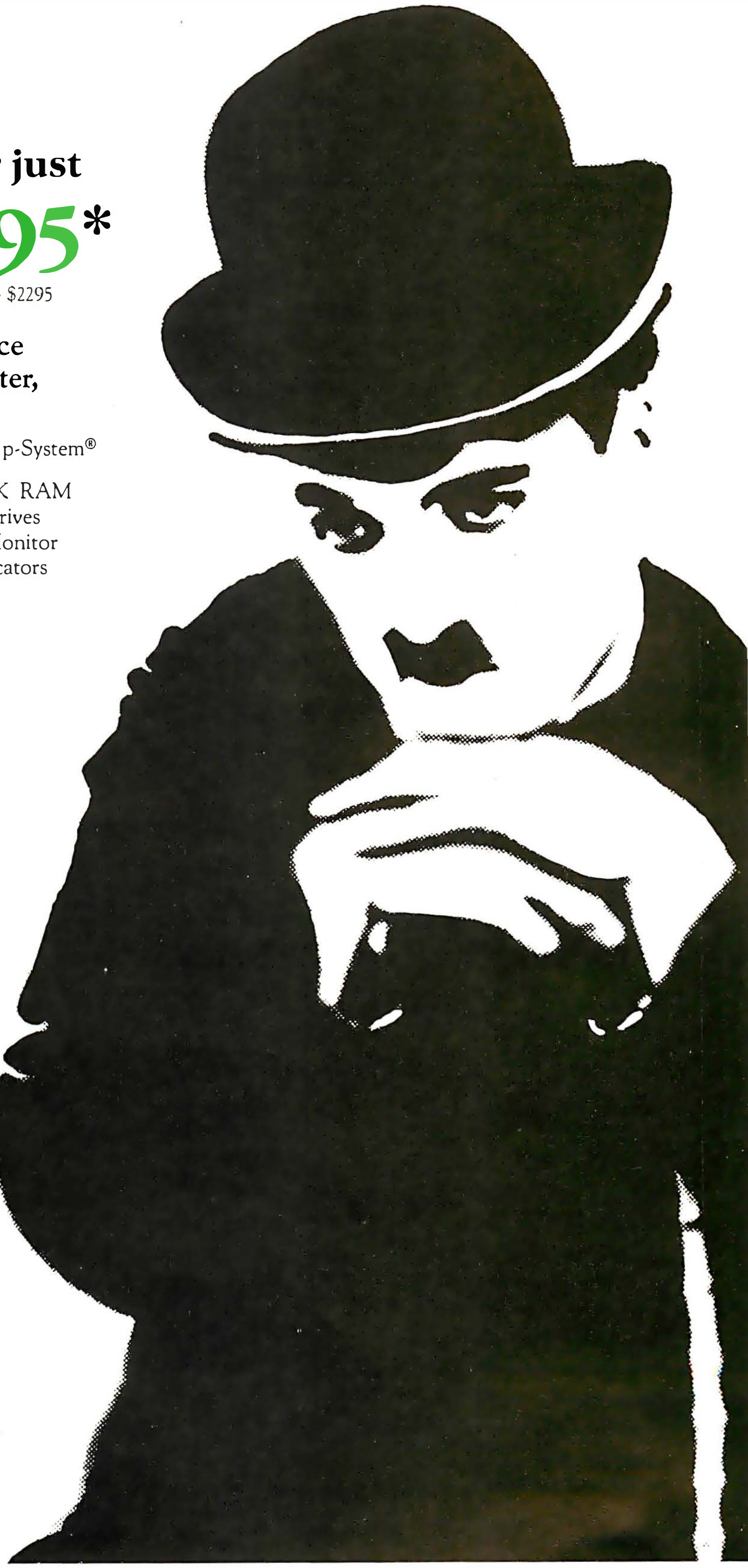
McCabe's weak point lies in the detail of complex subjects. For instance, the initial subjects in the beginning chapters—the stack, stack words, numeric operations, conditionals, and the like—are treated in careful detail but, as the book progresses, McCabe appears to be in a hurry to arrive at the end. I don't believe he spent as much time on the more complex aspects of FORTH as he did on the basics. This is unfortunate because it has been my experience that, in time, most users will master the operation of the stack and postfix notation, but some of the more elusive aspects of FORTH are a source of continual confusion. These include compilation, the vocabulary, array structures, floating-point math, multitasking, disk operation, and others.

Perhaps the most difficult aspect to understand in FORTH is the dictionary,

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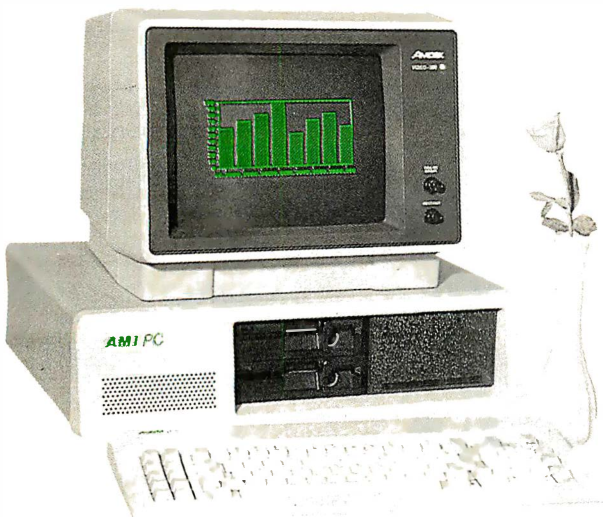
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dictionary fields, and linking. While McCabe devotes an entire chapter to this complex and confusing subject, I feel he would have done well to double his effort here, leading the novice FORTH programmer through more clearly mapped examples of dictionary operation. The examples he provides appear correct, but the chapter must be read more than once to fully grasp the content.

Contrary to claims made by FORTH advocates, FORTH is not an easy language to learn, especially for those unfamiliar with computer hardware concepts—an absolute necessity with FORTH. *Starting FORTH* takes a more fundamental, almost simplistic, approach to the language, and thus Brodie's book is best for the beginner. For instance, because Brodie assumes his readers do not know what constitutes a byte of memory, he explains it in detail, complete with drawings. McCabe does not bother.

Make no mistake, while FORTH is much more difficult to learn than BASIC, once mastered it is far easier and quicker to program in than most other popular languages; this is especially true in input/output-intensive applications.

Many Standards

One last observation. FORTH is still in the evolutionary stages of development. (I feel it always will be, due to its nature.) It can rightly be described as a roll-your-own programming language, and while there are standards, there are more unofficial variations to these standards than computer systems. This makes the job of writing a complete, accurate book covering FORTH an almost impossible task, in my opinion. McCabe wisely avoids the politics of FORTH standards and simply notes the differences between the more popular versions, generally FIG-FORTH and FORTH-79.

It's obvious, however, which standard McCabe believes in. His book convinced me that FIG-FORTH, not the original form of FORTH, is the only way to go. As new standards emerge (FORTH-83 is the latest), less and less flexibility is available to the programmer in terms of custom implementations.

I am only reviewing the first of two volumes. The second is simply a detailed glossary of FORTH and provides a quick, expanded reference source of the language. In Volume I, McCabe makes few references to Volume 2. Although the companion glossary is nice to have, I do not feel it is worth the retail cost.

Despite its flaws, *FORTH Fundamentals-Volume I* is a must for the serious FORTH programmer who requires an intimate understanding of the inner workings of this complex and versatile language. What is needed next is a FORTH applications book—McCabe just might be the one to do it.

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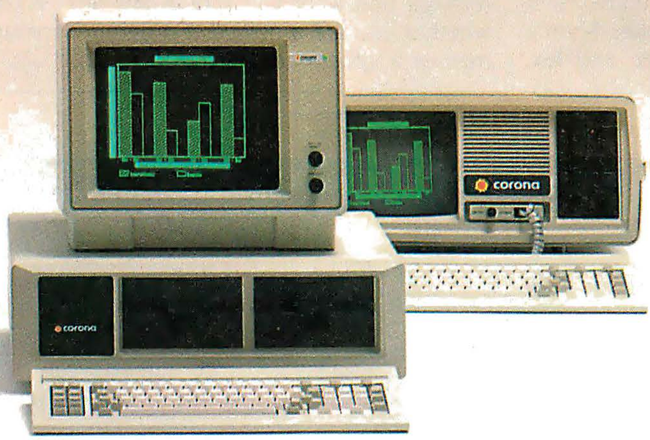


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THE UNIX OPERATING SYSTEM
Reviewed by Irene Pasternack

When I first looked at *The UNIX Operating System* by Kaare Christian, the only thing I could say was "Why another UNIX book?" I read this book in order to answer that question and discovered that, yes, there is an audience for the book.

Christian's book is well suited for the person with experience using another computer system who needs to learn about UNIX. It provides a conceptual overview rather than a tutorial for beginners. The first few chapters on history and fundamentals take up only 13 pages, so I actually read them instead of skipping them and missing some important concept. The second section, "Advanced UNIX System Topics," provides clear descriptions, examples, and relevant concepts on topics that any serious UNIX user needs to understand: shell programming, C, make, Source Code Control System, yacc and lex, system manager and programmers' utilities, and the UNIX kernel.

For Several Levels

The UNIX Operating System is also suitable for those who are learning UNIX as their first operating system but are beyond the basics. It fills in the concepts behind newly familiar commands and explains what your local system administrator or programmer is doing in a way a newcomer to computers can understand. It should be read after a class or practice with introductory books such as *The UNIX Primer Plus* by Mitchell Waite and Donald Martin (Howard W. Sams and Co., 1983) or A *User Guide to the UNIX System* by Jean Yates and Rebecca Thomas (Osborne/McGraw-Hill, 1982).

Appendixes include an abridged user's manual and a glossary of UNIX-specific terms. Christian does an excellent job of orienting you to what is relevant and what you should ignore, whether you are a novice, a programmer, or a system administrator.

The second chapter jumps into the UNIX system basics with a short warning to get you situated: "The UNIX System is harder to use than a toaster, but then it does more than a toaster. Learning the UNIX System is somewhat like learning a complex skill such as swimming or bicycle riding. At first none of your reflexes seem appropriate but eventually the skill is mastered."

People who consider themselves UNIX experts will probably remember this challenging phase of learning UNIX. The UNIX system, with all its built-in utilities and library functions, is an awesome tool that requires patience and an understanding of computers before you can learn how to use it. This book is designed to show you the major capabilities of this tool, rather than to teach you how to use it.

The following chapter covers the shell. For those uninitiated in UNIX, the shell is the part of the system that interprets your commands and acts on them. For

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example, a common action would be to load and execute a requested program, directing its input and output streams to specific files or to the terminal. The UNIX shell also has the capabilities of performing conditional commands. Because of this, it can essentially be used as an interpretive programming language. Christian discusses the shell's capabilities and presents many examples of ways it can be used.

The structure of the UNIX file system is presented from a user's point of view. Many of the utility programs that are presented include the text editor, a few basic utilities for handling your directory and files, finding out what's going on, and formatting text.

Advanced Topics

"Advanced UNIX System Topics" is the second part of the book and it will delight programmers and systems administrators without completely overwhelming more casual users. Topics covered include make and Source Code Control System, advanced shell use, security, C, programmer's utilities, yacc, lex, system manager's utilities, and the kernel. These topics are not usually covered in books on UNIX but are important for anyone intending to do serious work with UNIX. Each new topic is introduced with a description of why it is important and the concepts behind relevant commands. Examples show format, how to use the commands, and alternative ways to accomplish a goal.

Although I am a fairly sophisticated UNIX user, I found that conceptual holes in my knowledge were filled. A less experienced UNIX user, approaching these topics for the first time, found the concepts and explanations understandable. This is quite a feat considering the levels of complexity of yacc, lex, shell programming, the kernel, and C.

Christian's explanations of **yacc** and **lex** are good examples of the quality of the book for both novice and experienced users. For the novice, the concepts and need for recognizing a command language are explained and the commands are demystified. For the experienced user, enough information is provided to begin using lexical analysis and parsing for useful tasks.

I found the description of the UNIX kernel fascinating because it explains

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why UNIX works as it does. Because the user never interacts directly with the kernel, it is rarely covered in UNIX books. The kernel is the master behind-the-scenes organizer, scheduling processes, allocating disk storage and memory, and supervising data transmission between peripheral devices and the main processing unit. This section explains why you have to reboot and what happens inside the computer when you start up your system. It explains how processes are handled, relating the concepts of parent/child processes, multiuser timesharing, block and character I/O, all the way to the functioning of the kernel.

Errors

As with every book on UNIX that I've seen so far, there are a few technical errors. In the chapter called "Check File Systems," the command volcopy is explained as an alternative way to back up files on Version 7, but it is not available on the Version 7 I use. Christian also errs with the phrase, "only the system is allowed to write in directory files." Any users with write permission for a directory can write in the directory file. Occasionally, introductory paragraphs contain generalizations that are not completely accurate. For example: "Many UNIX Systems have several text editors, most of which resemble. . . ." ed, is misleading. Most people use a screen rather than a line editor, and only one of the popular screen editors is related to the line editor, ed.

Altogether, *The UNIX Operating System* is a well-written and useful book for those who are switching to UNIX from other systems or who are familiar with UNIX basics. It contains conceptual information and a wide range of topics not found in other recently published books on the UNIX operating system.

Artificial Intelligence Applications for Business
Reviewed by Hunter Alexander

Artificial intelligence (AI) interests people in business both as a tool for performing tasks that could not have been done before and as a new way of approaching old problems. Walter Reitman has edited the May 1983 proceedings of the New York University (NYU) Symposium relevant to this topic and they are published in *Artificial Intelligence Applications for Business*.

According to one contributor, in 1978 Schlumberger Ltd. of New York City began recruiting and equipping an AI group. To date, it has spent more than $21 million on researching improved techniques for locating gas and oil (the dipmeter project). Texas Instruments, Amoco, and Standard Oil of Ohio have similar programs. The fifteenth chapter, entitled "Market Trends in Artificial Intelligence," by Howard Austin, delves into this aggressive AI marketplace where, at present, large amounts of money are being spent, both by business and by the government. One knowledgeable AI businessman, Eamon Barret of Smart Systems Technology in McLean, Virginia, estimates that $300 million will be spent on AI in 1984. The book contains many such facts arranged in useful charts showing who's who on AI, how much money has been invested in certain projects, which people to contact, and what telephone numbers to call. Other tables list all known AI investors and contacts and their telephone numbers.

The book by itself will not help business people in developing a program that will enhance the company's productivity. Rather it is designed to bring the business person up to the speed of the AI industry.

A Sample Program

This book is divided into three parts: expert systems, natural language, and the future of the AI marketplace. Adrian Walker's chapter on "Databases, Expert Systems and Prolog," takes us inside IBM's San Jose research laboratory. He explains how Plantdoc, a natural-language system, diagnoses ailments that you enter about houseplants and then recommends remedies. Because Plantdoc is one of the easiest applications to explain, it serves as a good example of how people can enhance their businesses with increased service or productivity facilitated by an AI program. Although the program could be for home use, a customer can allegedly enter a plant store and describe a plant's symptoms, such as yellow leaves that are dropping off. The clerk then enters this information, the ailment is diagnosed, and the computer responds

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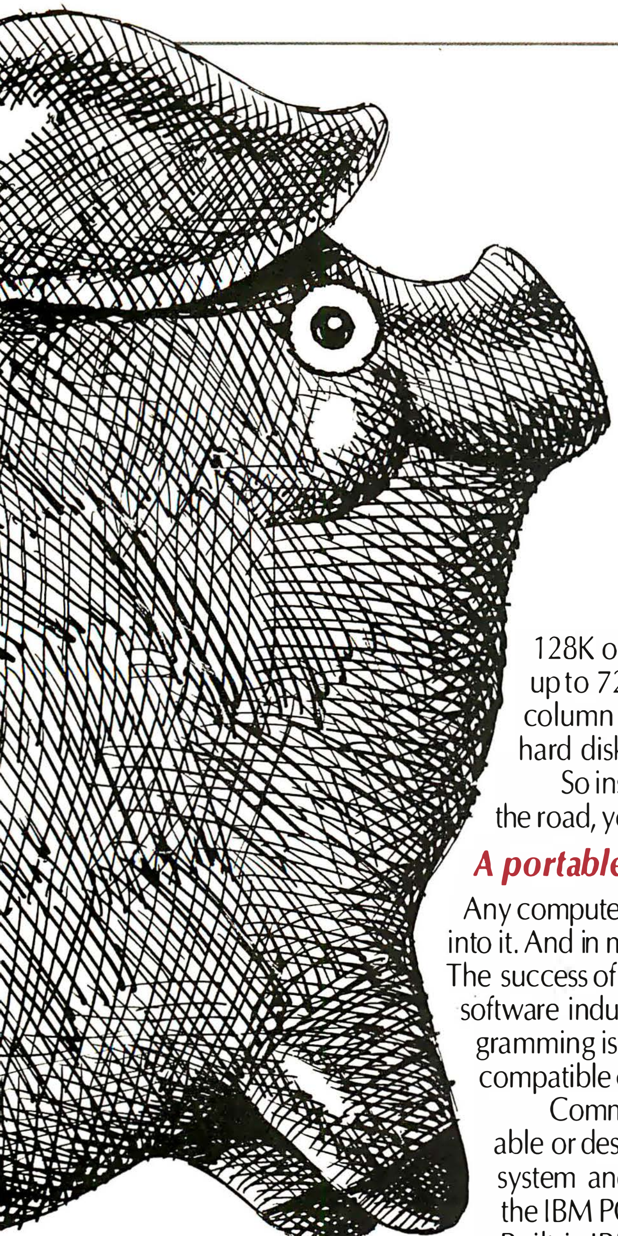
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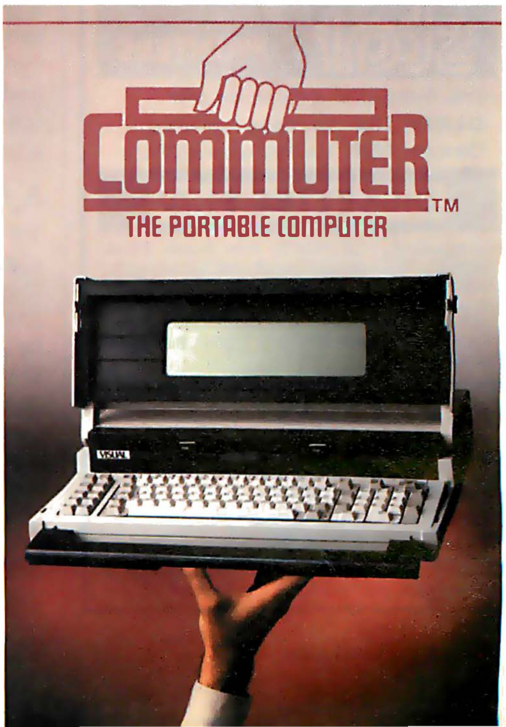
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with the appropriate remedy. On a less simplistic note, a similar procedure could be programmed for diagnosing what ails something as complex as a nuclear power plant, though we would certainly require a great deal of trust in the system and its information. Dr. Walker also tells how the Prolog language, used extensively in AI, provides powerful and practical means for integrating techniques in databases and expert systems. Digital Equipment Corporation, for example, has used expert systems to replace manuals and old-fashioned dumb databases. The corporation is presently automating manufacturing and assembly.

Other papers describe several applications that include knowledge-based systems, expert systems, natural-language interfaces, advisory systems, robotics, and intelligent database software.

This is no easy task. For a computer to interact with you it must be able to solve problems, answer questions, and recognize and respond to misconceptions. According to the authors of Chapter 12, Webber and Finin, there are four discernible types of user misconceptions: one, "that something exists"; two, "that something can participate in some relation"; three, a misconception about an object's type; and four, "that some event can occur." Further, there are times when even the user does not know how to answer or what information to supply. In these cases, the interactive process requires that the systems extract from the user the required data. "Without these capabilities," Webber and Finin claim, "interactive problem-solving systems will never be more than laboratory toys."

A Certain Future

Yet every discussion of AI should include some guesses about the future. The editor, Reitman, sees an increasing amount of AI software houses backed by venture capital from various sources. In the long run, AI is building and will continue to market software because certain professionals can benefit from it. "If there is a population of people who regularly buy knowledge or who could buy knowledge to avoid costly problems or who routinely perform tedious knowledge-based inference in their work, conjecture is that a commensurate knowledge system product would appeal to that market."

The opinions and stylistic problems in this book call for the reader to forgive these authors, because they are explorers of a new galaxy. Some of them will undoubtedly find more oil and copper, diagnose more diseases, invest wisely in the stock market, or maybe even win a space war.

Audience

This book would help someone setting up an artificial language department in a company, preparing to buy an AI product, and preparing to hire an AI consultant. A venture capitalist pondering an investment in AI would make a better transaction after reading this book. Someone planning to perform AI consulting, programming, or related work would do well to read Reitman. A professor teaching AI might hesitate to assign this book because of the price, but it will probably be on reserve in many libraries.

The contributors are all established experts. Reitman himself has drawn conclusions for readers to entertain about AI. He started 1983 teaching at NYU Graduate School of Business Administration. He organized or helped organize a conference on AI. The conference was a hit. Reitman got an offer he could not refuse. He now works for Bolt Beranek and Newman Inc., of Cambridge, Massachusetts, one of the more successfull AI firms and contractor for the Navy and DARPA (Defense Advanced Research Projects Agency).

Reitman considers that people considering incorporating AI in their firms encounter two obstacles. He has attempted to address the first with the symposium proceedings, namely, "figuring out what AI is." The second matter takes more grappling: determining how a firm should apply AI. Because no two firms are alike, each one must decide on its specific expectations, answering questions such as: Do you want to implement AI for marketing or productivity? Will you design your applications or rent them? How far do you want this new implementation to extend?

Reitman suggests the next steps after symposia are books and articles; seminars; consultants; product, service, and development firms; demonstrations; in-

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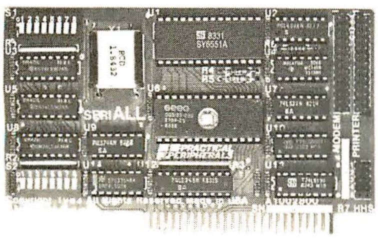
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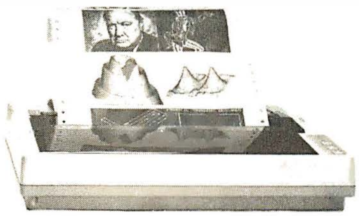


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The Controversy

"A rule-based approach may encourage a false sense of security in capturing expertise," we are told. This book both warns where the pitfalls are as well as brags about the successes of AI.

Coping with uncertainty is a concern shared by many. This book explains how some AI products have succeeded in coping better than any intuitive devices we have used in the past.

In the last chapter Reitman warns of the shortcomings of AI. Apparently, it has not yet lived up to the promise of its academic acolytes.

Questions about natural language and artificial intelligence seldom produce crisp answers. (To speculate, UFO reports began about the same time as AI research.) Some interesting results have been achieved; books come out; conferences are held. But people in business are left with the feeling that the shortage of substantial answers can be expensive. Other reports on AI can also be expensive, but this book is one of a kind and may help defer costly errors. ■

Michael O'Neill (2227 Dwight Way #4, Berkeley, CA 94704) is interested in mathematics, electronics, and music.

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Irene Pasternack is managing director of Specialized Systems Consultants (POB 7, Northgate Station, Seattle, WA 98125) and teaches UNIX seminars. She is also Chairperson of the Seattle Area UNIX Users Group.

Hunter Alexander (4520 King St. #404, Alexandria, VA 22302, (703) 820-8304) is BYTE's Washington correspondent whose interest in AI is supplemented by past experience as a researcher in the Office of Naval Intelligence. He was also a consultant on defense and translator of technical Russian material.

BYTE is always looking for qualified book reviewers. Submit queries and proposals accompanied by a resume, writing samples, or a list of computer-related interests and expertise to Book Review Editor, POB 372, Hancock, NH 03449.

July 1984

● C, UNIX COURSES
Courses in C Language and UNIX, Concord, MA, Somers Point, NJ, and College Park, MD. Three five-day courses are offered: "C Programming Workshop," "Advanced C Topics Seminar," and "UNIX Workshop." Contact Joan Hall, Plum Hall Inc., 1 Spruce Ave., Cardiff, NJ 08232, (609) 927-3770. *July–August*

● DATABASE SEMINARS
SoftwareBanc Seminars, various sites in the U.S. and Canada. Such seminars as "Problem Solving with 1-2-3," "dBASE II," and "Exploring UNIX" are planned. Contact SoftwareBanc Inc., 661 Massachusetts Ave., Arlington, MA 02174, (800) 451-2502; in Massachusetts, (617) 641-1241. *July–August*

● DBM SEMINARS
Digital Consulting Associates Classes and Seminars, various sites in the U.S. Seminars and classes on information centers, database administration, and other microcomputer topics. Contact Digital Consulting Associates Inc., 339 Salem St., Wakefield, MA 01880, (617) 246-4850. *July–August*

● ENGINEERING SUMMER CONFERENCES, Chrysler Center, North Campus, University of Michigan, Ann Arbor. Topics include aerospace, chemical, electrical, nuclear, marine, metallurgical, mechanical/automotive, industrial, and computer, information, and control engineering. Fees range from $450 to $1000, depending on course length. Contact Engineering Summer Conferences, 200 Chrysler Center—North Campus, University of Michigan, Ann Arbor, MI 48109, (313) 764-8490. *July–August*

● WORKSHOPS FOR EDUCATORS, Compuworkshops Computer Seminars for Educators, various locations in California. Among the seminars offered are "Designing Educational Courseware," "Computer Literacy for Educators," and "How to Set Up a Computer-Based Education Program in Your School or District." Each course is $50. Contact Compukids of Seal Beach, Rossmoor Shopping Center, 12385 Seal Beach Blvd., Seal Beach, CA 90740, (213) 430-7226; in West Los Angeles, (213) 473-8002; in Tarzana, (213) 343-4008; and in Rancho Bernardo/San Diego, (619) 451-1742. *July–August*

● DEC SEMINARS
Technical and Management Seminars for Professionals, various sites in the U.S. Subject areas: system-performance management, networking, personal computing, applications design and programming, real-time applications design, and management development. On-site seminars can be arranged. Contact Educational Services, Seminar Programs BUO/E58, Digital Equipment Corp., 12 Crosby Dr., Bedford, MA 01730, (617) 276-4949. *July–September*

● EFFICIENT COMPUTING TECHNIQUES, Microcomputers: Techniques for Improving Your Computer Efficiency, Valley Inn and Tavern, Waterville Valley, NH. Four intensive two-day seminars: "Microcomputers: Programming in BASIC," "Introduction to VisiCalc," "Micro Database Applications," and "Engineering and Management Applications." Tuition is $495, or $679 with meals and lodging. Contact New Hampshire College, Resource Center, 2500 North River Rd., Manchester, NH 03104, (603) 668-2211, ext. 175. *July–September*

● MANAGERIAL SEMINARS
Computer Competence Seminars, Boston University Metropolitan College, Boston, MA. A series of hands-on presentations tailored for managers who know little or nothing about computers and for those who wish to sharpen their computing skills. On the docket are "PCs for Improving Financial Analysis and Decision Support," "Personal Computers for Sales and Marketing Professionals," and many others. Fees range from $225 to $595. In-house programs can be organized. Contact Joan Merrick, University Seminar Center, Suite 415, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020. *July–September*

● RAINBOW SEMINARS
All-Hands-On, Boston, MA, Chicago, IL, New York City, and San Francisco, CA. A series of applications seminars featuring the DEC Rainbow 100. Contact Carol Ericson, BUO/E50, Educational Services, Digital Equipment Corp., 12 Crosby Dr., Bedford, MA 01730, (617) 276-4572. *July–September*

● HIGH-TECH TUTORIALS
Tutorial Short Courses from Hellman Associates, London, England, and various sites in the U.S. Among the courses offered are "VLSI Design," "Digital Control," and "Error Correction." Fees are generally $895. Contact Hellman Associates Inc., Suite 300, 299 California Ave., Palo Alto, CA 94306, (415) 328-4091. *July–October*

● PROFESSIONAL EDUCATION
Seminars from the Institute for Professional Education, various sites in the U.S. Programs in statistics, management, simulation and modeling, personal computers, and computer science. Contact the Institute for Professional Education, POB 756, Arlington, VA 22216, (703) 527-8700. *July–December*

● NCC
The 1984 National Computer Conference—NCC, Convention Center, Las Vegas, NV. Professional-development seminars, more than 650 exhibits, and nearly 100 technical sessions. Contact the American Federation of Information Processing Societies Inc., 1899 Preston White Dr., Reston, VA 22091, (703) 620-8926. *July 9–12*

● FIBER-OPTIC METHODS
Fiber and Integrated Optics, San Diego, CA. Course topics: single- and multimode fiber cabling, photo detectors, receiver and repeater technology, and optical-fiber sensors. The fee is $875. Contact Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (202) 676-6106. *July 9–13*

● SPECIAL EDUCATION INSTITUTE, Microcomputers in Special Education: Today's Challenge, Lesley College, Cambridge, MA. Subjects: Logo, software evaluation, administrative applications, and model programs. Technical expertise not required. Contact Joy Nikkel, Lesley College, 29 Everett St., Cambridge, MA 02238, (617) 868-9600. *July 16–20*

● SIMULATION CONFERENCE
Summer Computer Simulation Conference—SCSC '84, Copley Plaza Hotel, Boston, MA. Technical sessions, papers, panel discussions, exhibits, and tutorials. Contact Charles Pratt, Simulation Councils Inc., POB 2228, La Jolla, CA 92038, (619) 459-3888. *July 23–25*

● SIGGRAPH
ACM SIGGRAPH '84, Minneapolis, MN. Technical papers, panel discussions, a design show, film and video presentations, and nearly 30 courses. Contact SIGGRAPH '84 Conference Office, 111 East Wacker Dr., Chicago, IL 60601, (312) 644-6610. *July 23–27*

● INTERFACING TIPS FOR TEACHERS, Microcomputer-based Instrumentation for Schools, Middletown, OH. An introductory, hands-on workshop for college and secondary teachers. Contact Bill Rouse, 301 McGuffey Hall, Miami University, Oxford, OH 45056, (513) 529-2141. *July 23–August 2*

(continued)

● HEATH/ZENITH USERS MEET International Heath/Zenith Users' Group Conference, Pheasant Run Resort, St. Charles, IL. Contact the Heath Users' Group, Hilltop Rd., St. Joseph, MI 49085, (616) 982-3463. *July 27–29*

● MICROS IN EDUCATION Stanford Institute on Microcomputers in Education, Stanford University, Stanford, CA. An intensive session that provides the background necessary to serve as a school or district resource person. Hands-on programming, word processing, and administrative computing. Contact Stanford Institute on Microcomputers in Education, POB K, Stanford, CA 94305, (415) 322-4640. *July 30–August 31*

● WORKSTATION IN OFFICE EXPLAINED, Software and Hardware for Interactive Workstations, Washington, DC. Demonstrates how to solve business problems by using distributed information systems. The design, operations, components, and possible results of a communications workstation will be explored. Tuition: $695. Contact Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (202) 676-6106. *July 30–August 1*

● ROBOTICS STRATEGIES Robot Manipulators, Computer Vision, and Automated Assembly, Massachusetts Institute of Technology, Cambridge. This short course emphasizes ways of developing strategies for solving such robotic problems as sensing, spatial reasoning, and manipulation. Existing industrial robots and binary-vision systems will be covered. Contact the Director of the Summer Session, Room E19-356, MIT, Cambridge, MA 02139. *July 30-August 3*

August 1984

● SME CONFERENCES & EXPOS, Conferences and Expositions from the Society of Manufacturing Engineers, various sites in the U.S. and around the world. A calendar is available. Contact the Public Relations Department, Society of Manufacturing Engineers, One SME Dr., POB 930, Dearborn, MI 48121, (313) 271-0777. *August*

● SCHOOL COMPUTER COORDINATORS, The Computer: Extension of the Human Mind, Center for Advanced Technology in Education, University of Oregon, Eugene. For individuals responsible for the use of computers and emerging technologies at the school and district levels. Pre- and post-conference workshops. Registration is $95. Contact Summer Conference Office, College of Education, University of Oregon, Eugene, OR 97403. *August 1–3*

● SHOW FOR TARHEELS Great Southern Computer Show, Civic Center, Charlotte, NC. Hardware, software, peripherals, and accessories for the home and office. Seminars and workshops. Contact Great Southern Computer Shows, POB 655, Jacksonville, FL 32201, (904) 356-1044. *August 2–4*

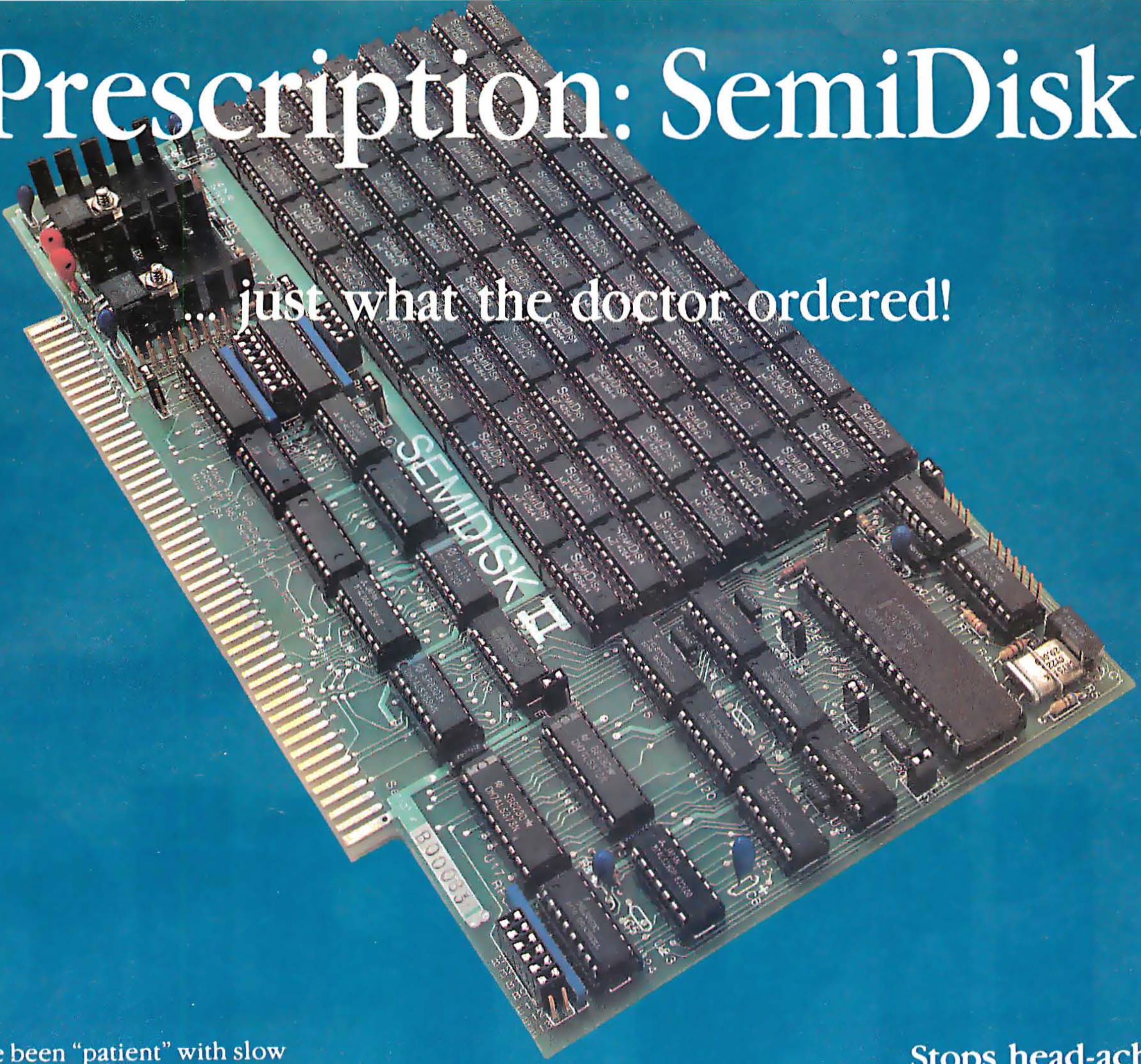
● HOME AND OFFICE The First Annual Tampa Bay Computer Show & Office Equipment Exposition, Curtis Hixon Convention Center, Tampa, FL. Hardware, software, accessories, and peripherals for industry and home. Contact CompuShows Inc., POB 3315, Annapolis, MD 21403, (800) 368-2066; in Annapolis, (301) 263-8044; in Baltimore, 269-7694; in the District of Columbia, 261-1047. *August 2–5*

● AI INVESTIGATED The National Conference on Artificial Intelligence, Performing Arts Center, University of Texas, Austin. Seminars, exhibits, and panel discussions. Registration for American Association for Artificial Intelligence (AAAI) members is $100; nonmembers pay $140. Contact Claudia C. Mazzetti, AAAI, 445 Burgess Dr., Menlo Park, CA 94025, (415) 328-3123. *August 6–10*

● COMPUTERS IN ENGINEERING, The 1984 ASME International Computers in Engineering Conference and Exhibit, Hilton Hotel, Las Vegas, NV. More than 60 panel discussions and paper sessions. Product exhibits. Contact American Society of Mechanical Engineers, 345 East

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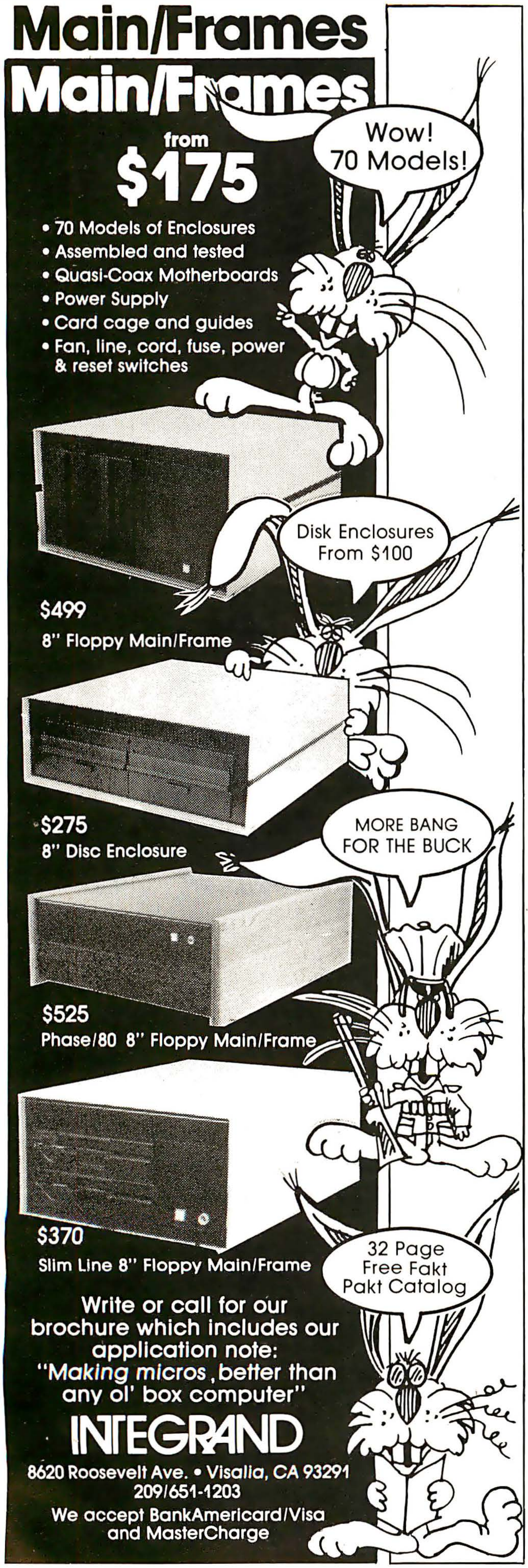
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● MICROS & VOC EDUCATION Microcomputers and High Technology in Vocational Education Conference, Vocational Studies Center, University of Wisconsin, Madison. Concurrent sessions, formal classes, presentations, speeches, and videotaped programs. Preregistration fee is $55, or $65 at the door. Contact Dr. Judith Rodenstein, 964 Educational Sciences Building, University of Wisconsin, 1025 West Johnson St., Madison, WI 53706, (608) 263-4367. *August* 13–16

● COMPUTERS AND BIOLOGY The Fourth Annual Notre Dame Short Course Series: Computers in Biology, University of Notre Dame, Notre Dame, IN. Three concurrent short courses: "Computers in Bioeducation," "Microcomputers in Classroom and Laboratory," and "Computerized Data Analysis in Biological Research." Technical expertise is not required. Tuition is $450. Contact Theodore J. Crovello, Biocomputing Short Course Coordinator, Department of Biology, University of Notre Dame, Notre Dame, IN 46556, (219) 239-7496. *August* 13–17

● COMPUTING IN SCHOOLS The Third Annual Harvard Institute on Computing in Schools, Harvard Graduate School of Education, Cambridge, MA. Designed for educators and administrators. Software demonstrations and group discussions will be featured. Prior computer experience not required. Contact Institute on Computing in Schools, Programs in Professional Education, Harvard Graduate School of Education, 339 Gutman Library, Cambridge, MA 02138, (617) 495-3572. *August* 13-17

● PROGRAM COMPUTER GAMES, Programming Games on Computers, Salzburg Inn, Stowe, VT. Presented by Monty Newborn and David Levy, computer-game experts, this course is designed to show you how to program a computer to play chess, bridge, othello, checkers, and blackjack. Ability to program in BASIC, FORTRAN, or Pascal is advised. The fee is $550. Contact Dr. Monty Newborn, 4874 Westmount Ave., Westmount, Quebec H3Y 1Y1, Canada, or call (514) 481-1766. *August* 13-17

● COMPUTERS, GRAPHICS, AND BUILDING, Computers/Graphics in the Building Process—BP '84, Embarcadero Center, Hyatt Regency San Francisco, CA. Exhibit of equipment and services, tutorials, and technical sessions exploring the theme "The Building Process in Transition." Contact Conference Director, BP '84, Suite 333, 2033 M St. NW, Washington, DC 20036, (202) 775-9556. *August* 19-23

● ADA COURSE, Hands-On Programming in Ada, Washington, DC. Upon completion students will be able to design, code, and test Ada programs in an interactive environment. Enrollment is limited to individuals with programming experience in at least one high-level language. The fee is $875. Contact Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (202) 676-6106. *August* 20-24

● PROGRAM COMPUTER GAMES, Programming Games on Computers, Salzburg Inn, Stowe, VT. See August 13-17. *August* 20-24

● COMPUTERFEST/HAMFEST The Central Pennsylvania Repeater Association Eleventh Annual Hamfest/Computerfest, Hershey, PA. Indoor dealer and flea-market areas. Registration is $3. Children and spouses free. Contact Timothy R. Fanus, WB3DNA, 6140 Chambers Hill Rd., Harrisburg, PA 17111, (717) 564-0897 (noon to 8 p.m.). *August* 26

● INFO CENTER CONFERENCE Information Center Conference and Exposition, Sheraton Boston and Hynes Auditorium, Boston, MA. More than 60 educational sessions on hardware, software, and organizational topics of interest to information-center managers will be featured. Contact Warren/Weingarten Publications, 38 Chauncy St., Boston, MA 02111, (617) 542-0146. *August* 26-30

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● PCB TECHNICAL SEMINAR
The 1984 Printed Circuit Fabrication Technical Seminar, Boston, MA. Contact Donna Esposito, PMS Industries, 625 Sims Industrial Blvd., Alpharetta, GA 30201, (404) 475-1818. *August* 27–29

● EUROMICRO
The Tenth Annual Euromicro Symposium—Euromicro 84, Copenhagen, Denmark. One of the largest European computer events, Euromicro features speeches, tutorials, and technical sessions. Also featured will be the annual Euromouse contest in which robotic mice zip through a maze, racing against time and foreign competitors. Contact Euromicro, p/a TH Twente, Department INF, Room A306, POB 217, 7500 AE Enschede, The Netherlands; tel: (31) (53) 338799; Telex: 44200 THES. *August* 27-30

September 1984

● ERGONOMICS CONFERENCE
World Conference on Ergonomics in Computer Systems, various sites throughout the U.S. and Europe. Ergonomic experts and computer professionals and users will exchange information and observations. Contact Computer Psychology Inc., 54 East Main St., POB 16, Mendham, NJ 07945, (201) 543-9009. In Europe, Telefonaktiebolaget LM Ericsson, LM Ericssons väg 4-8, S-12625 Stockholm, Sweden; tel: (8) 7190000. *September-October*

● SHOWS IN GERMANY
Chip Microcomputer Weeks, various sites throughout West Germany. Microcomputer products, trends, and applications will be demonstrated. Sponsored by *Chip*, a leading German computer magazine. Contact Network GmbH, An der Friedenseiche 10, D-3050 Wunstorf 2, Bundesrepublik Deutschland (West Germany); tel: (0 50 33) 10 56; Telex: 92 45 45. In England, Network Events Ltd., Printers Mews, Market Hill, Buckingham MK18 1JX, England; tel: (02 80) 81 52 26; Telex: 83111. *September-November*

● INTEL WORKSHOPS
Microcomputer Workshops, various sites throughout the U.S. and Canada. Intel, the semiconductor memory manufacturer, is offering more than 20 workshops on microprocessor applications. A brochure is available. Contact Customer Training, Intel Corp., 27 Industrial Ave., Chelmsford, MA 01824-3688, (617) 256-1374. *September-December*

● IBM SYSTEMS SHOW
The IBM System User Show, Olympia 2, London, England. Covers the full spectrum of IBM mainframes, minicomputers, and microcomputers. A focus on business. Contact EMAP International Exhibitions Ltd., 8 Herbal Hill, London EC1R 5JB, England; tel: 01 837 3699. *September* 3-5

● AI IN EUROPE
The Sixth European Conference on Artificial Intelligence, Pisa, Italy. Covers programming languages, expert systems, natural-language processing, robotics, and computer vision. Tutorials. Contact the Programme Chairman, Institute of Educational Technology, Open University, Walton Hall, Milton Keynes MK7 6AA, England. In Italy, Stefano A. Cerri, Dipartmento di Informatica, Universita di Pisa, Corso Italia, 40, Pisa 56100, Italy; tel: Pisa 40862/3/4; Telex: CNUCE 500371. *September* 5-7

● SOFTWARE ONLY
The Second Annual National Software Show, Convention Center, Anaheim, CA. An exposition and conference devoted solely to microcomputer software. Contact Raging Bear Productions Inc., Suite 175, 21 Tamal Vista Dr., Corte Madera, CA 94925, (800) 732-2300; in California, (415) 924-1194. *September* 5-7

● COMPUTER INTERFACING FOR SCIENCE
Personal Computer and STD Computer Interfacing for Scientific Instrument Automation, Washington, DC. A hands-on workshop costing $395. Contact Dr. Linda Leffel, C.E.C., Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, (703) 961-4848. *September* 6-8

● MOTION CONTROL SEMINAR
Electronic Motion Control Seminar, Boston, MA.

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Replacement keyboard for the Radio Shack TRS-80 Color Computer*
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KB 925
Plug-compatible with the Televideo 925*
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KB 5150 and 5150 jr — The Professional Series
KB 5150 is plug-compatible with the IBM* PC and XT. KB 5150 jr. is plug-compatible with the IBM PC jr.* Both are available in DVORAK and foreign layouts, and a special model is made for the handicapped.
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Sponsored by the Electronic Motion Control Association. Contact EMCA Headquarters, Suite 1200, 230 North Michigan Ave., Chicago, IL 60601, (312) 372-9800. *September* 10-11

● ELECTRONICS SHOWS
Midcon 84 and Mini/Micro Southwest 84, Dallas, TX. Concurrent conferences exploring practical applications and the state of the art of electronics, including computers, graphics, and networks. Contact Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, CA 90045, (213) 772-2965. *September* 11-13

● UNIX EXPOSITION
UNIX Systems Expo/84, Convention Center, Los Angeles, CA. Exhibits from more than 200 vendors of UNIX-related products and services, as well as presentations and panel discussions. Contact Computer Faire Inc., 181 Wells Ave., Newton, MA 02159, (617) 965-8350. *September* 11-14

● EUROPEAN COMPUTER GRAPHICS, Eurographics '84—The Fifth Annual European Computer Graphics Congress, Copenhagen, Denmark. A congress with an international lineup of speakers and product exhibits. Contact Kenness International, 1 Park Ave., New York, NY 10016, (800) 235-6400; in New York, (212) 684-2010. *September* 12-14

● SOFTWARE EXPO
The Fifth Annual Software/Expo, Hyatt Regency, Chicago, IL. A conference and exposition. Contact Software/Expo, Suite 205, 2400 East Devon Ave., Des Plaines, IL 60018, (312) 299-3131. *September* 12-14

● TECHNOLOGY FOR DISABLED, Computer Technology for the Handicapped, Raddison South Hotel, Minneapolis, MN. A national conference and exhibit for special education, rehabilitation, and medical professionals. Presentations and workshops. Registration is $150 before September 1; $175 after. Admission to the exhibit floor only is $3. Contact Closing the Gap, POB 68, Henderson, MN 56044, (612) 665-6573 or (612) 341-8299. *September* 13-16

● GULF COAST COMPUTING
The Heart of Texas Computer Show, Bayfront Plaza, Corpus Christi. Seminars and displays. Contact Heart of Texas Computer Show, POB 12094, San Antonio, TX 78212, (512) 681-2248. *September* 14-16

● PEOPLE AND COMPUTERS
The 1984 SME World Congress on Human Aspects of Automation, Hotel du Parc, Montreal, Quebec, Canada. Contact Society of Manufacturing Engineers, One SME Dr., POB 930, Dearborn, MI 48121, (312) 271-1500, ext. 369. *September* 16-19

● COMPUTERS AND MODERN WORLD, COMPCON Fall 84, Hyatt Regency Crystal City, Arlington, VA. Tutorials, panels, demonstrations, sessions, and papers will explore the theme "Small Computer (R)Evolution." Contact COMPCON Fall 84, IEEE Computer Society, POB 639, Silver Spring, MD 20901, (301) 589-8142. *September* 16-20

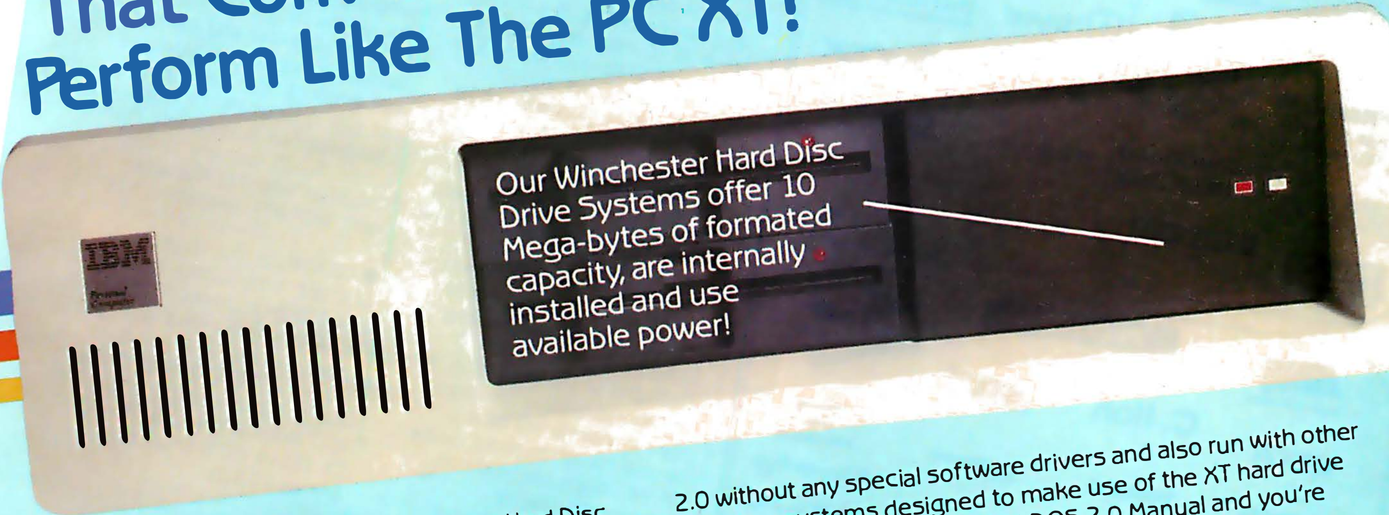
● MEDICINE, BIOLOGY, ENGINEERING, The Thirty-Seventh Annual Conference on Engineering in Medicine and Biology, Los Angeles Hilton, Los Angeles, CA. Papers, short courses, and scientific and commercial exhibits will be featured. Contact The Alliance for Engineering in Medicine and Biology, Suite 402, 4405 East-West Highway, Bethesda, MD 20814. *September* 17-19

● ADA WORKSHOP
Future Ada Environment Workshop, Miramar Hotel By-the-Sea, Santa Barbara, CA. Workshops, addresses, presentations, working groups, and discussions. Registration: $400 to $700 depending on room choice. Contact ACM AdaTEC Future Ada Environment Workshop, TRW R2/1134, One Space Park, Redondo Beach, CA 90278, or register directly with Carolyn Gannon, GRC, POB 6770, Santa Barbara, CA 93160. *September* 17-20

● KENTUCKIANA EXHIBITION
CompuFest '84, Commonwealth Convention Center, Louisville, KY. Computer consultant services and approximately 100 hardware, software, peripheral, and word-processing system vendors will display exhibits.

(continued)

NOW! Choose From 3 Hard Disc Drive Systems That Convert Your IBM* PC To Perform Like The PC XT!

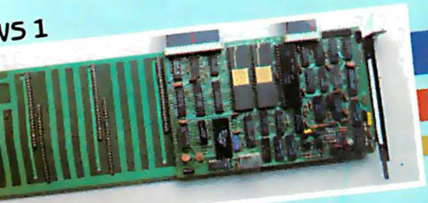


Maynard Electronics introduces three Winchester Hard Disc Drive Systems — the only drive systems to offer you 10 Mega-bytes of formatted capacity with complete internal installation! These systems offer the user countless benefits and features: capability of booting off the hard disc; additional functions while requiring only **one** card slot in your PC; and, use of available power, thereby preventing overheating problems which have affected other drives. Handling heavyweight data was never easier.

All three systems are quality engineered and work with DOS 2.0 without any special software drivers and also run with other operating systems designed to make use of the XT hard drive system. All you need is the IBM* DOS 2.0 Manual and you're ready to run!

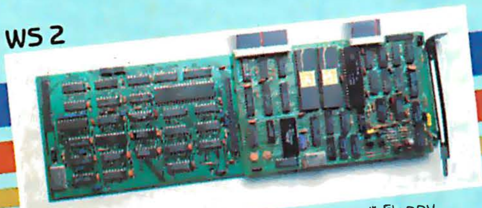
Each system is equipped with a low-power hard disc drive, complete software, cable, a SandStar™ Card and Hard Disc Controller Module. SandStar™ is the first family of modular peripherals created for the IBM* PC. Simple instructions for easy installation are included and all components are backed by an Unconditional One Year Parts and Labor Guarantee.

WS 1



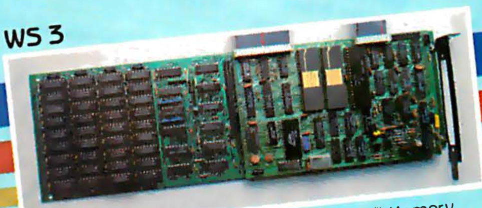
System is equipped with the SandStar™ Multi-ction card. In addition to the Hard Disc Controller dule, you can add up to three other SandStar™ dules while using only **one** card slot. The following dules are available: Serial Port, Parallel Port, Clock lendar, Game Adaptor, and Prototyping Module.

WS 2

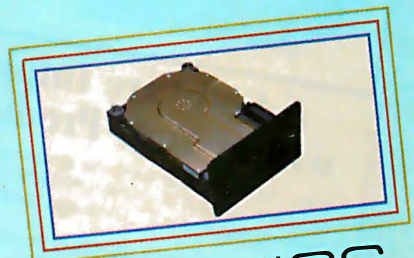


This System is equipped with the SandStar™ Floppy Drive Controller Card. The Card can control, in addition to the Hard Disc Drive, two floppy drives mounted inside your PC and optionally two additional 5¼" or 8" drives mounted externally. This leaves three system slots for other expansion boards.

WS 3



This System is equipped with the SandStar™ Memory Card. In addition to controlling the Hard Disc Drive, the Memory Card allows you to add 64K bytes to 576K bytes of memory using only one card slot.



pand your PC to perform like the PC XT, one of our Winchester Hard Drive Systems is right for you. And if you have already made the decision to install any of Maynard's SandStar™ Cards, the Star™ Hard Disc Controller Module may be purchased separately.

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Technical sessions will be offered. A full day's worth of seminars costs $15. Registration fee is $2. Contact the Kentucky Society of CPAs, 310 West Liberty St., Louisville, KY 40202, (502) 589-9239. *September* 18-20

● PARISIAN COMPUTING
The Thirty-Fifth SICOB—International Exhibition of Data Processing, Teleprocessing, Communication, Office Procedures, and Office Systems, CNIT, Paris-La Défense, Paris, France. Microprocessing and videotex will be major highlights of the exhibition. International visitors presenting their passports will have a special reception room. Some of the congresses and conferences will feature simultaneous interpretation in English and French. Contact International Trade Exhibitions in France, 8 West 40th St., New York, NY 10018, (212) 869-1720. *September* 19-28

● EDUCATIONAL CONFERENCE
The First North Carolina Educational Microcomputer Conference, Benton Convention Center and Hyatt Hotel, Winston-Salem. Educational sessions, hands-on workshops, and product displays. A network of various computers will be set up. Contact Jeanette Gann, NC Regional Education Center, POB 21889, Greensboro, NC 27420, (919) 379-5764. *September* 20-21

● DOCUMENTATION METHODS
How to Document a Computer System, Holiday Inn—Thomas Circle, Washington, DC, and Hyatt Cherry Hill, Cherry Hill, NJ. A series of documentation procedures will be presented. The fee is $155. Contact Technical Communications Associates, Suite 210, 1250 Oakmead Parkway, Sunnyvale, CA 94086, (800) 227-3800, ext. 977; in California, (408) 737-2665. *September* 21 and *September* 24, respectively

● PACIFIC COAST FAIR
The Fifth Annual Pacific Coast Computer Fair, Robson Square Media Centre, Vancouver, British Columbia, Canada. This event features exhibits, user-group displays, and more than two dozen speakers. Workshops, presentations, and panels will discuss the Apple Macintosh, MS-DOS, software and hardware marketing, publishing, Modula-2, and graphics. Admission is $4 per day. Contact Pacific Coast Computer Fair Association, POB 80866, South Burnaby, British Columbia V5H 3Y1, Canada, (604) 581-6877. *September* 22-23

● GRAPHICS STANDARD COURSE, Introduction to GKS, Hyatt Regency Hotel, Austin, TX. A course on the Graphics Kernel System (GKS) standard. The fee is $495. Contact Nova Graphics International Corp., 1015 Bee Cave Woods, Austin, TX 78746, (512) 327-9300. *September* 24-25

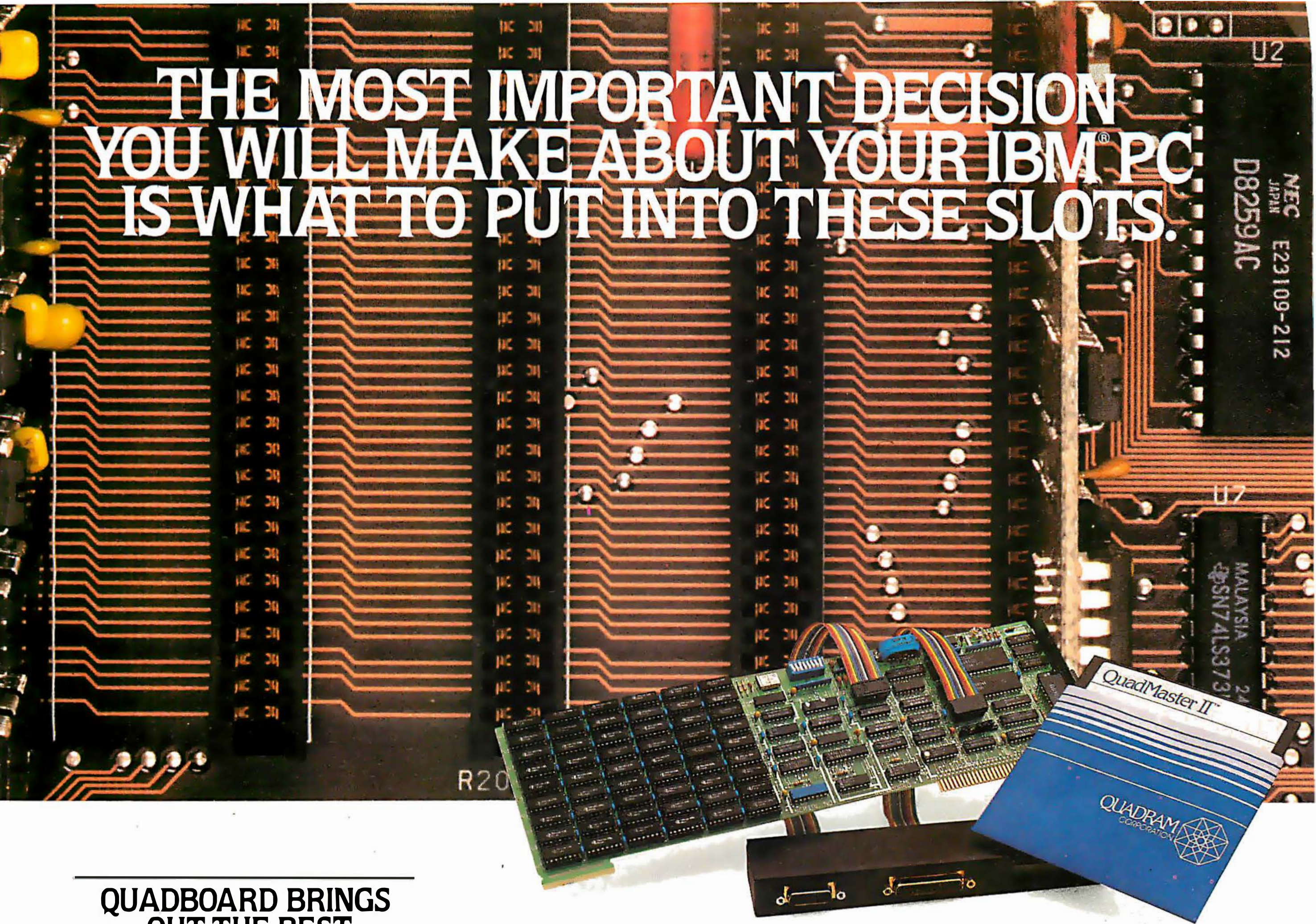
● ASIAN COMPUTER SHOW
The Fifth South East Asia Regional Computer Conference and Exhibition and Hong Kong Computer 84, Hong Kong Exhibition Centre, China Resources Building, Wanchai, Hong Kong. Contact Cahners Exposition Group, 7315 Wisconsin Ave., POB 70007, Washington, DC 20088, (301) 657-3090. *September* 24-27

● COMPUTERS, COMMUNICATIONS, AND CONTROL
Eurocon 84—The Sixth European Conference on Electrotechnics, Brighton, England. A conference that seeks to identify the impact of computer-based technology on communications and control. Contact Manager, Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, England; tel: 01-240 1871, ext. 222; Telex: 261176. *September* 26-28

● MID-ATLANTIC SHOW
The Fifth Annual Mid-Atlantic Computer Show and Office Equipment Exposition, Convention Center, Washington, DC. Contact CompuShows Inc., POB 3315, Annapolis, MD 21403, (800) 368-2066; Annapolis, (301) 263-8044; Baltimore, 269-7694; District of Columbia, 261-1047. *September* 27-30. ■

IF YOU WANT *your organization's public activities listed in BYTE's Event Queue, we need to know about them at least four months in advance. Send information about computer conferences, seminars, workshops, and courses to Event Queue,* BYTE *Publications, POB 379, Hancock, NH 03449.*

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4. **A game port** for joy sticks and paddles.
5. **An I/O bracket** to organize expansion port connectors.
6. **A battery powered chronograph** for an up-to-date internal clock/calendar.
7. **QuadRAM Drive*** to set up multiple RAM drives in memory.
8. **MasterSpool*** for a software print buffer.
9. **Qswap*** to swap printers without changing cables.
10. **MasterCache*** a disk caching system that speeds up programs that frequently read data from a disk.

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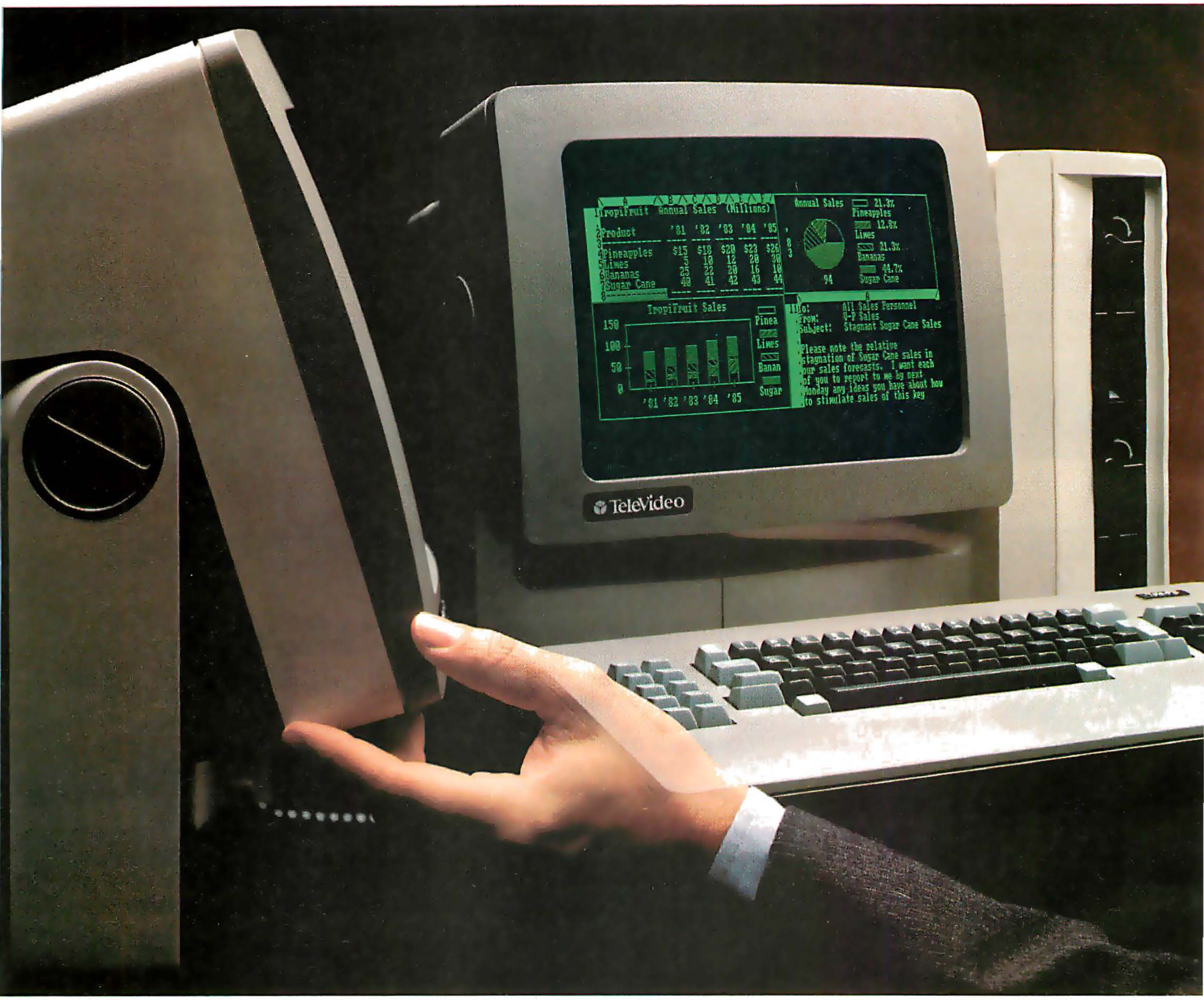
*Included as part of QuadMaster II software.

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THE BEST HARDWARE FOR THE BEST PRICE.

Features	Tele-PC	IBM PC	Tele-XT	IBM XT
Monitor	YES	OPTIONAL	YES	OPTIONAL
Screen Size	14"	12"	14"	12"
Tilt Screen	YES	NO	YES	NO
Quiet Operation	YES (NO FAN)	NO	YES	NO
Memory	128K	128K OPTION	256K	256K OPTION
Graphics Display (640x200 resolution)	YES	OPTIONAL	YES	OPTIONAL
Printer Port	YES	OPTIONAL	YES	OPTIONAL
Communication Port	YES	OPTIONAL	YES	YES
MS™-DOS/BASIC®	YES	OPTIONAL	YES	OPTIONAL
System Expansion Slot	YES	YES	YES	YES
RGB and Video Port	YES	OPTIONAL	YES	OPTIONAL
Typical System Price	**$2995**	**$3843**	**$4995**	**$5754**

compatibles. the best software.

and has the standard—not optional—features you need to take full advantage of every job your software can do.

Study the chart at the left. It proves that TeleVideo—not IBM—offers the best hardware for the best price.

Note that TeleVideo's ergonomic superiority over IBM extends from fully sculpted keys and a comfortable palm rest to a 14-inch, no glare screen that tilts at a touch.

THE BEST MICROCHIPS.

What is perhaps most impressive about the TeleVideo IBM PC Compatible can be found deep within its circuitry. We use the same 8088 central processing unit that runs an IBM PC. But we also employ new VLSI (Very Large Scale Integration) microchips that are designed and built exclusively for TeleVideo.



These interface more efficiently with the powerful 8088 and yield numerous benefits.

For example, our tiny custom chips do the work of many of the larger, more expensive circuit boards in an IBM PC. So we can offer a computer system that comes in one attractive, integrated case, is ready to run and occupies less desk space. A computer that edges out IBM's added-cost component system for reliability, ease of service and purchase simplicity.

Fewer circuit boards to cool also allowed us to eliminate the noisy, irritating fan IBM and most other PCs force you to put up with. And TeleVideo compatibles accept any IBM hardware options without modification.



THE BEST PORTABLE FOR THE BEST PRICE.

Features	TPC II	COMPAQ
High Capacity Storage	YES	NO
2nd Disk Drive	YES	OPTIONAL
Quiet Operation (No Fan)	YES	NO
Ergonomic Display	YES	NO
Communication Port	YES	OPTIONAL
International Power Supply	YES	NO
MS™-DOS 2.11	YES	NO
Graphics Display	YES	YES
Typical System Price	**$2995**	**$3710**

THE BEST LINE.

But the Tele-PC is only one element of the TeleVideo IBM PC Compatible line.

The TeleVideo XT is the best hardware for users of popular IBM XT software who would appreciate an extra 10 megabytes of storage capacity along with the advantages listed on the preceding chart.

As the chart above demonstrates, our portable IBM compatible computer, the TPC II, is far and away better hardware than COMPAQ.™ Better hardware—standard—at a better price.

THE BEST MANUFACTURER.

The TeleVideo IBM PC Compatible line is made by the world leader in multi-user computer systems and the number one independent manufacturer of terminals.

Our compatibles are available at participating ComputerLand and Entré (call 800-HI-ENTRE) dealers or you may call 800-538-8725 for the dealer nearest you. In California, call 800-345-8008.

Before you invest, make a few simple comparisons. You'll find that TeleVideo—not IBM or COMPAQ—has the best hardware for the best software. At the best price.

IBM is a registered trademark of International Business Machines. MS is a trademark of MicroSoft Corporation. GW Basic is a registered trademark of MicroSoft Corporation. COMPAQ is a trademark of COMPAQ Computer Corporation.



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Readers Catch Bugs in Real-Time Article

The lengthy code accompanying Dr. David K. Broadwell's article "Real-Time Clocks and PC-DOS 2.0" (January, page 442) received considerable scrutiny from BYTE readers. One reader, Larry Waibel, caught a bug in the INIT (i.e., initialization) code at the end of Dr. Broadwell's system clock/driver program, which is based on the IBM PC macro-assembly language. In an attempt to pass to the operating system the end of the permanent part of his program with an offset of 0 and the breakpoint in the segment register, Dr. Broadwell added a few bytes to the segment register. The result was that the program gobbled up 12K bytes of extra memory. The fix is shown here in listing 1.

Listing 2 shows you how to maneuver the INIT section to force it to a paragraph boundary and an offset of 0.

Another problem occurs because the operating system will try to verify its Write to the clock chip after the VERIFY-ON command is executed. This issues a command to output with verify to the driver. Bill Anderson suggests a fix: Remove the OUT_VERIFY: label from the Error Return Stack and place it adjacent to OUTPUT.

Listing 1. *The excessive appetite of the* INIT *code section of* Dr. Broadwell's *program can be curbed with this patch.*

```
INIT:
      MOV DX,OFFSET INIT
      MOV ES:BR_ADDR_0[BX],DX          ;OFFSET OF END
      MOV ES:BR_ADDR_1[BXZ],CS         ;SEGMENT OF END
;make that the break address
```

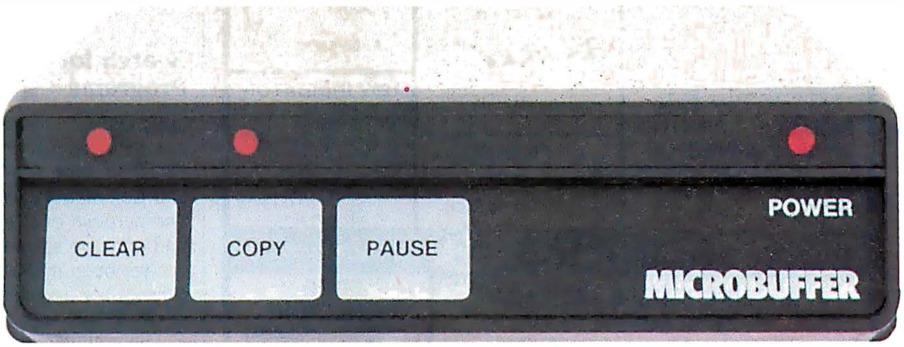
Listing 2. *The* INIT *section can be forced to a paragraph boundary and an offset of* 0 *passed using these maneuvers.*

```
      CSEG SEGMENT PARA PUBLIC 'CODE'
      START = $                        ; gives paragraph bound for
                                         ref
      .
      .
      .
      IF ($-START) MOD 16              ;adjust to para boundary
      ORG ($-START + 16 -(($-START) MOD 16)
      ENDIF
INIT:
      PUSH CS
      POP AX
      MOV DX,OFFSET INIT               ;get bytes to here
      MOV CL,4                         ;get ready for div by 16
      SHR DX,CL                        ;convert to paragraphs
      ADD AX,DX                        ;plus current code segment
      MOV ES:WORD PTR BR_ADDR_0[BX],0
      MOV ES:BR_ADDR_1[BX],AX
etc.
```

Communications Failure

An editing error resulted in an inaccurate description of the Frobco-Development System in May's What's New (page 514). It works in conjunction with the ColecoVision console to develop prototype software. Its cartridge adapter will operate on either the ColecoVision console or the Adam computer. Any program in the interface unit can be read, modified, and run through the ColecoVision. The system allows users to access the ColecoVision's memory space and I/O channels, and the manual provides information and a disassembled listing of the ColecoVision's operating system. The 32K-byte interface box plugs into the ColecoVision and not the Adam. A Coleco cartridge, however, may play on either machine. ■

WAIT REDUCTION MADE EASY.



You know how hard it is to wait for the printer to finish before using the computer again. It's wasteful! Counter productive!

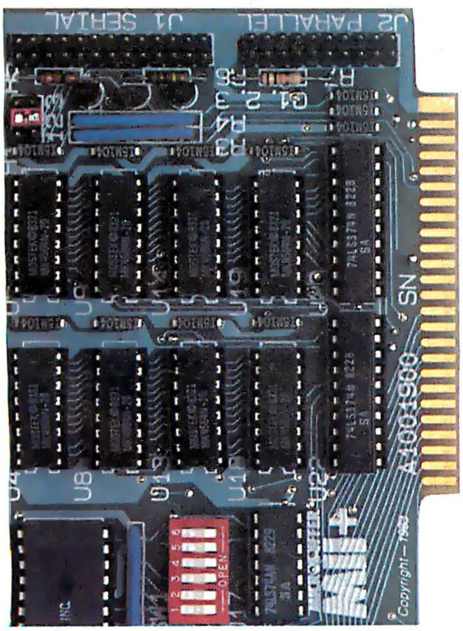
The solution: simply install Microbuffer™ printer buffer into the system, in seconds. And you can print and process simultaneously.

With one swift command, all printing data is dumped to the Microbuffer—it handles the printer and frees the computer for other functions.

Presto! Instant wait reduction.

Microbuffer II and II+ for the Apple II, II+, and IIe computers.

Microbuffer II comes in either a serial or a parallel version with 16K or 32K of RAM. Microbuffer II+, available with 16K, 32K or 64K, has both serial and parallel capabilities, so you can control two different printers at once. The Microbuffer II+ has on board high resolution graphics routines for 37 popular printers, and all include expanded graphics capabilities and text formatting in addition to the inherent benefit of letting you use your computer while your printer is working.

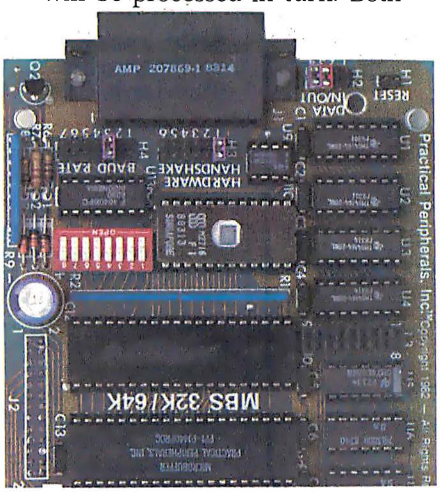


Microbuffer In-line for virtually any computer/printer combination.

These are stand-alone units that install In-line between virtually any computer and printer.

Besides printer buffering, the In-line serial interface (MBIS) can be used to efficiently transmit data from the computer to almost any device using a serial RS-232C interface. The parallel Microbuffer In-line (MBIP) is built exclusively for parallel interfacing, and works exceptionally well in virtually any parallel computer and any parallel printer.

Each of the stand-alone models have controls for making multiple copies (up to 255). With the pause control, printing may be halted at any point and continued later—it will pick up right where it left off. Even while you are printing copies of a document, additional files can be sent to the buffer and they will be processed in turn. Both come with either 32K or 64K of RAM, and are easily upgradable up to 256K for processing greater amounts of data.



Microbuffer/E for Epson printers.

Fully compatible with Epson MX, FX, RX, and IBM-PC series printers, these easy-to-install boards simply plug inside the printer.

For parallel interfaces, the Microbuffer models MBP-16K and MBP-64K are available.

For serial interfacing, Microbuffer models MBS-8K and MBS-32/64K are available. The MBS-8K supports both hardware and software (X-ON/X-OFF) handshaking; the MBS-32/64K supports three handshaking configurations (hardware, software X-ON/X-OFF and ETX/ACK).

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Search for Marketable Programs

Independent Software Evaluation Services has announced its Great Software Search for Atari and Commodore 64 computers. The purpose of the search is to find effective software that has not yet been marketed. Search winners are awarded $1000 worth of hardware for their machine. Winning entries are also submitted to software publishers for evaluation and possible marketing.

The deadline for the Great Atari Software Search is July 31. The Great Commodore 64 Software Search runs through Halloween. Before submitting your program, obtain a Software Submission Package from Independent Software Evaluation Services, POB 27463, Minneapolis, MN 55427.

Microcomputer Software Directory for Administrators and Educators

The Guidance and Counseling Directory of Microcomputer Software was developed by the Santa Clara County Office of Education for school administrators and educators. This directory describes and lists the required hardware and specifications for more than 100 computer programs. If you'd like more information about this directory, write to Janey H. Powers, Career/Vocational Education/Guidance Department, Santa Clara County Office of Education, Mail Code 236, 100 Skyport Dr., San Jose, CA 95115.

ANSI Seeks Comments on International Standards

The American National Standards Institute is seeking comments on a number of Draft International Standards (DISs) on information systems, which are currently being considered for approval by the International Organization for Standardization (ISO).

ISO DISs can be obtained from ANSI's International Sales Department. All orders must include titles, corresponding ISO Draft International Standard numbers, and remittance. Comments should be sent to Daniel W. Smith, American National Standards Institute, 1430 Broadway, New York, NY 10018. Comments will be collated and transmitted to the U.S. Technical Advisory Group that prepares the American position for ISO work on information systems. The following is a partial list of ISO DISs being considered.

- ISO/DIS 7069, *Small Computer-to-Computer Peripheral Bus Interface—Data Transfer Between Computer and Peripherals.* Price: $29. Forward comments by August 11. This DIS is designed to facilitate the compatibility and common use of equipment produced by different manufacturers as well as the interchangeability of such equipment between different systems. It contains the functional, electrical, and mechanical specifications that have to be met for full compatibility of all equipment in a computer at interconnection points.
- ISO/DIS 8278/1, *Data Communications—Network Service Definition.* Price: $40. Forward comments by August 11. This is one standard in a series involving the Open Systems Interconnection (OSI) Basic Reference Model. It is designed to facilitate the convergence of capabilities offered by subnetwork providers. It specifies the characteristics of a conceptual Network Service and supplements the Reference Model in guiding the development of Network Layer protocols.

User-Supported Spreadsheet

Freecalc is a user-supported electronic-spreadsheet program for the IBM PC. It has 100 rows and columns and provides a number of basic formulas that help both novices and experts create a spreadsheet. Freecalc lets you point the cursor to the cells to be included in the formula, and it has an area for you to enter your own formulas.

Freecalc comes with three sample spreadsheets and a tutorial. It requires 128K bytes of RAM for PC-DOS 1.1 and 192K bytes of RAM for PC-DOS 2.0 and 2.1. It's available for $35, or you can send a formatted blank disk to the author and make a contribution at a later date. Contact Steve Stilwell, Stilwell Software Products, 16403 North 43rd Dr., Glendale, AZ 85306. ■


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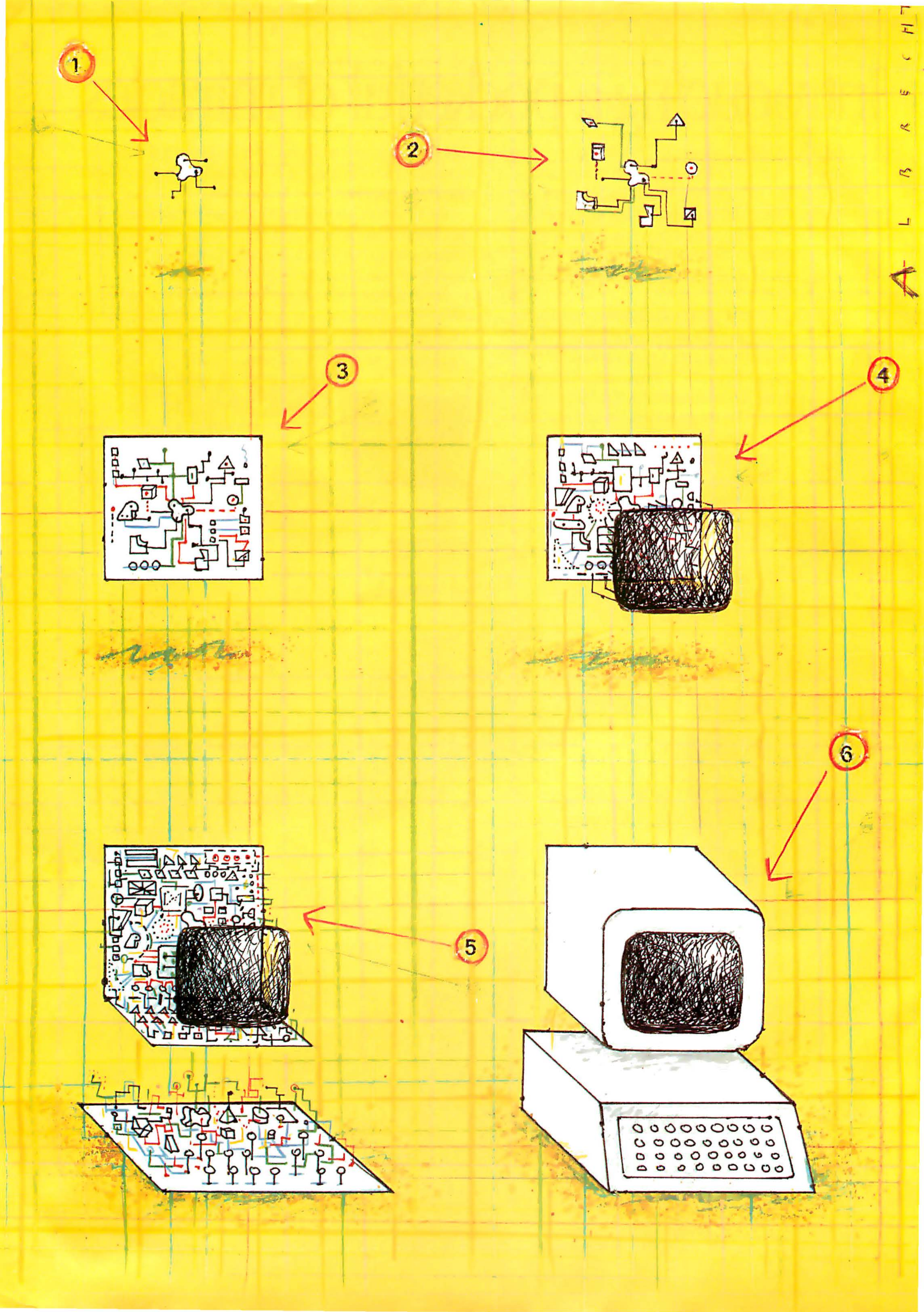
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Features

THIS SUMMER'S HOTTEST BATTLE won't be between rival baseball teams or even rival football leagues, but between the purveyors of integrated software. Lotus Development Corporation's Symphony takes on Ashton-Tate's Framework while Ovation Technologies' Ovation, Business Solutions' Jack2, Peachtree's Decision Manager, and many lesser contenders scramble to offer personal computer users more action. To find out what drives this important new technology, we begin examining window-based, multifunction software this month with a product preview of Symphony. Contributing Editor Rik Jadrnicek's examination of Lotus 1-2-3's heir apparent catalogs a list of impressive functions; a future review will assess whether the added capabilities encumber or enhance an already successful product.

This month's trip to Steve Ciarcia's Circuit Cellar finds BYTE's resident tinkerer putting together a sound circuit that can give your telephone a distinctive chime instead of a standard ring. As usual, Steve's work might be a springboard for other projects, such as adding music to a doorbell, dashboard, or digital alarm clock.

The BYTE Computer Show held in Chicago's McCormick Place in May gave Steve Ciarcia and Jerry Pournelle an opportunity to visit and talk with readers. The crowds around the BYTE booth indicated that one or the other of these popular editors was holding court. If you've not yet made it to a consumer-oriented computer show, you'll appreciate Pournelle's feature on the West Coast Computer Faire, held this past March in San Francisco. Jerry reports with his usual flair and eye for interesting products.

The first computer language invented by a committee, COBOL (Common Business Oriented Language), will be 25 years old next year. Labeled archaic by most programmers, COBOL applications nevertheless number in the tens of thousands and constitute the bulk of the nation's data-processing industry output. Will the newest committee-generated language, the Department of Defense's Ada, fulfill a similar legacy 25 years from now? Last month's beginning primer on Ada explored the language's modular, unitized structure and control statements. In this month's concluding installment, author Sabina H. Saib puts together an Ada toolbox of useful functions along with the source code (written in a microcomputer subset of Ada called Janus Ada) of all the examples illustrated in both parts of the series.

Kermit, the file-transfer protocol discussed last month in an Education theme article, is investigated further this month in the second of two installments. Last month's introduction examined how this protocol, developed at Columbia University, facilitates communication among micro-, mini-, and mainframe computers. Frank da Cruz and Bill Catchings discuss states, transitions, and heuristic rules and provide a sample sequence of packets from an actual file transfer.

Next month, we'll have a product preview of Framework and we begin a two-part examination of the new 16-bit version of the 6502 microprocessor as Steve Hendrix chronicles the specs of the 65816. Also, Senior Technical Editor Gregg Williams discusses the use of software toolkits and David Hinnant reports on benchmarking UNIX systems.

—G. *Michael Vose, Senior Technical Editor, Features*

SYMPHONY
A FULL-ORCHESTRA VERSION OF LOTUS 1-2-3

BY RIK JADRNICEK

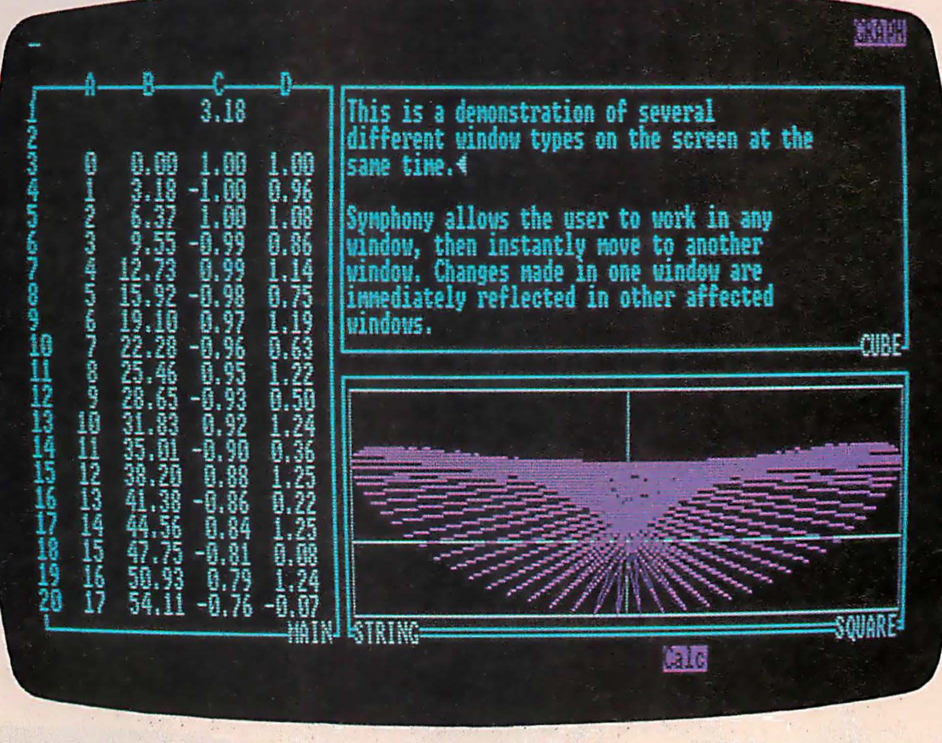


Photo 1: A *three-window display highlights* Symphony's *ability to depict a spreadsheet, document, and graph in color on the screen at the same time.*

Editor's Note: *The following is a* BYTE *product preview. It is not a review. We provide this advance look at this new product because we feel it is significant. A complete review will follow in a subsequent issue.*

Symphony is a full-fledged integrated package created by Lotus Development Corporation. The name is an allusion to the original product's likeness to a chamber music group, while the new one's features are numerous and varied. It is priced at $695 and current Lotus 1-2-3 users can upgrade to Symphony for $200.

I am an experienced Lotus 1-2-3 user and I recently secluded myself in a room with a large pot of coffee, an IBM PC, and Symphony. Here is what I discovered.

In a nutshell, Symphony includes and improves upon the Lotus 1-2-3 spreadsheet, graphics, and database capabilities while adding new word-processing and data communications environments. All this is enhanced by powerful macro files and the Symphony command language.

THE MASTER ENVIRONMENT

A 256-column by 8192-row spreadsheet is the master environment for the SHEET (spread-

(continued)

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sheet), DOC (word processing), GRAPH (business graphics), COMM (data communications), and FORM (database) subenvironments of Symphony.

Like Lotus 1-2-3, the whole work environment is still memory-bound. With a 256K-byte IBM PC, Symphony showed 187,270 bytes free for modeling. I was able to fill 8 columns by 1925 rows with an 8-digit number (that's 29 single-spaced, typewritten, 8½ by 11 pages)—to take full advantage of Symphony, I would need more RAM (random-access read/write memory). (*Lotus recommends a minimum of 320K bytes of RAM for Symphony.—Eds.*)

You can create and name any number of windows overlooking this workspace. Each window can operate as one subenvironment (for example, as a spreadsheet). The same window can then be changed to another subenvironment. Within the same window you might start out typing a letter, then change that window environment to a spreadsheet to enter some formulas, then change back to the document environment to continue the letter.

Window names can be up to 15 characters long and include spaces. The layout of the windows can be as small as one character or as large as the screen. They can be freely moved around the screen and can be piled on top of each other like papers on a desktop, or even filed away for later use. While paging from one window to the next, you can zoom into the window of your choice, making it fill the monitor screen. You can even completely eliminate window borders or you can change them to solid lines to give your integrated model a customized appearance.

Since all the windows and subenvironments you create overlook one master environment, the entire scenario is interactive. At your option, any changes you make in one window will be reflected in the others. In fact, in the process of developing formulas you can move from window to window picking up variables. Different windows can be formatted independently, and you can restrict the area they look upon. It's easy to switch among various environments, share data among environments, and use several environments simultaneously, thus achieving a high level of integration.

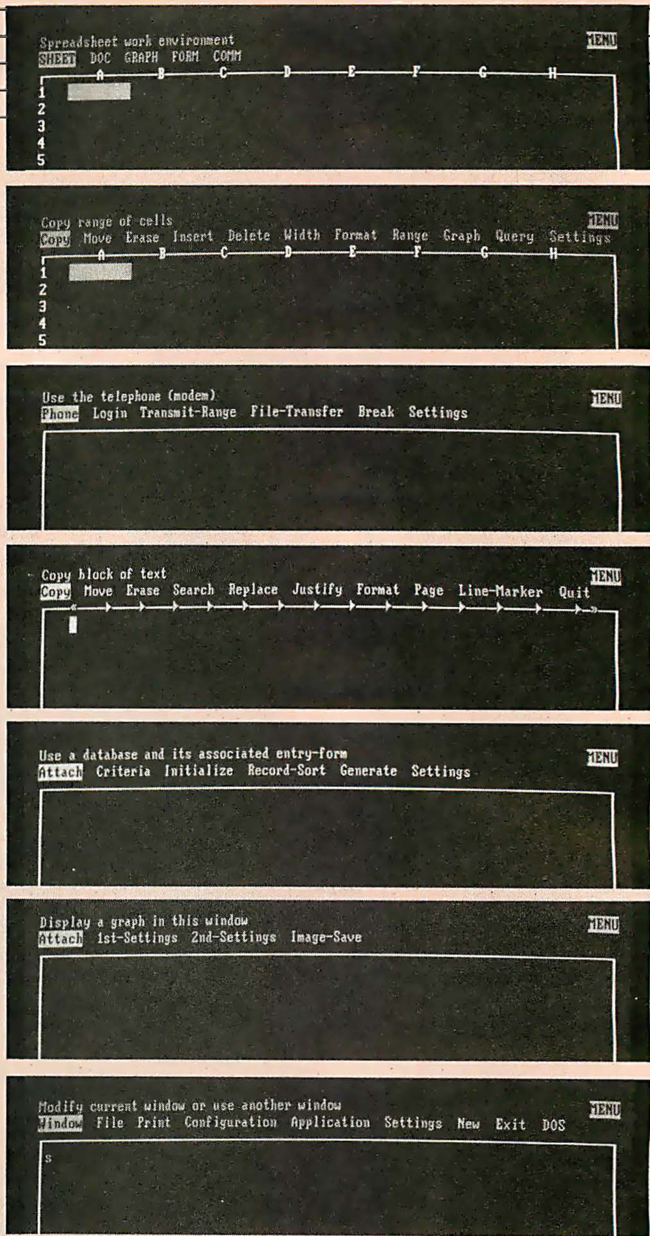


Photo 2: *A full complement of Symphony menus, beginning with a start-up menu followed by spreadsheet, communications, word processing, database, graph, and a window-management menu.*

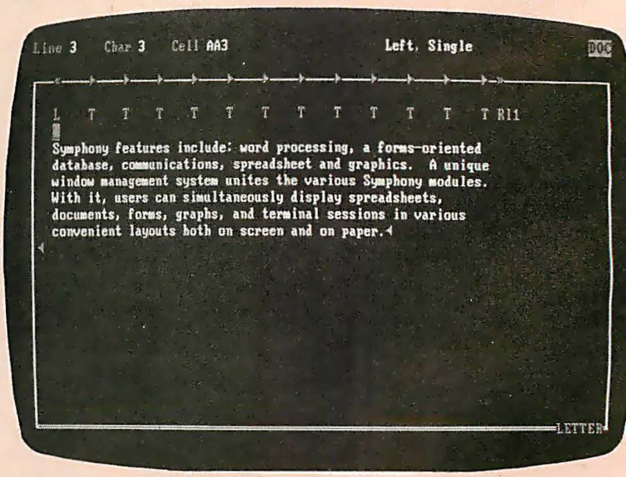


Photo 3: *A text sample in a word-processing window.*

Services and Environment Menus

Most of the commands used with Symphony are divided into two groups: services and menus. Pressing the F10 key on the IBM PC will present a set of tiered menus for the current active environment. For example, if you are in a window with the spreadsheet environment active, pressing the F10 key will give you access to the commands pertaining only to spreadsheets. A window with the DOC environment active would display the command menu used for word processing. The menus are therefore less complex and more focused on the task at hand.

Pressing the F9 key on the IBM PC displays the service menu giving you access to the commands common to all windows. You can then manipulate windows or disk files and configure the printer or program defaults. Within the services menu, cells can be protected and the entire worksheet can be locked against the editing of protected cells. A user-defined password is needed to unlock the spreadsheet.

Special application utilities can be attached to Symphony from the services menu. One such application is the DOS (disk operating system) window. This enables you to return to DOS with two keystrokes. When you execute those two keystrokes, the screen blanks and the A> prompt appears. You can run DOS utilities or even another program, RAM permitting. Typing "exit" at the A> prompt takes you out of DOS and returns you to Symphony.

Setting Sheets

Symphony lets you create Setting sheets to hold default values for printer settings and characteristics of the various environment windows. For example, you can create and store a variety of Setting sheets, each describing a different printer or printout format. A catalog of the sheets is kept for your review and selection for different applications. Communications parameters, database designs, graph specifications, word-processor formats, and spreadsheet characteristics all have Setting sheets.

The sheets are filled out by selecting options from menus similar to the command menus. When making the choices, the screen goes blank briefly and the Setting sheet reappears to reflect the changes. Each sheet created serves as a recap and can be dynamically updated, so you are seeing all values and changes as they are made. The use of Setting sheets further simplifies use of the program.

The special numeric pad keys have been put to good use in Symphony. All of them are used and the functions they perform are consistent from environment to environment. The scroll key actually warrants scrolling. In the document environment, it permits jumping 25 percent of a page in horizontal and vertical directions. In the spreadsheet environment, you can easily move to the end of data, column, or row. Lotus Development makes good use of the special keys on the IBM PC, especially the function keys (see figure 1). This,

Most commands are divided into two groups: services and menus.

coupled with the more focused menus of Symphony, speeds up the process of model building considerably and minimizes confusion.

The Spreadsheet Environment

The spreadsheet capabilities of Symphony are certainly not diluted. Lotus 1-2-3 is in full force and includes some new tricks. Global formats, recalculation order (including iteration count), title fixes, and global column widths are now conveniently displayed together in a Setting sheet. As you change the values, the full-screen Setting sheet changes dynamically—a real treat.

Remember that any window can become a spreadsheet environment and all windows are viewports onto the same master spreadsheet. When in the spreadsheet environment, only the menu items neccessary for spreadsheet development are presented. Copying, moving, and erasing cells, ranges, and blocks is a breeze. Direct access is given to spreadsheet-oriented graphics and database commands to develop the Setting sheets for those environments (see graphics and database environments).

(continued on page 372)

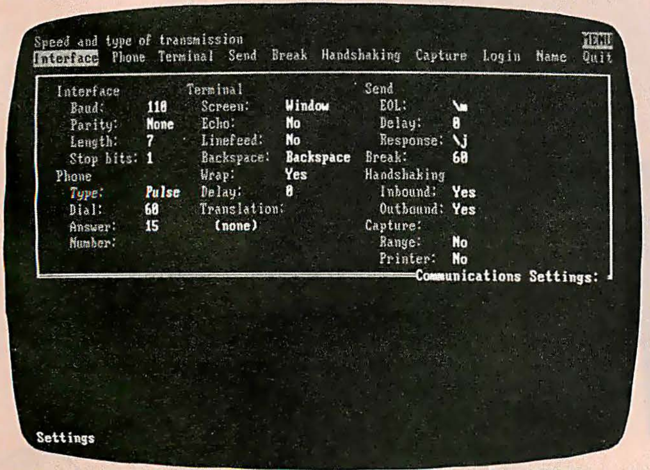


Photo 4: A *Setting window for communications parameters.*

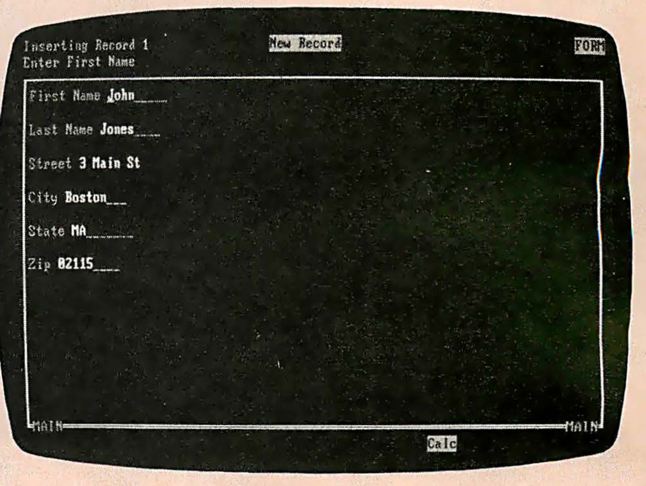


Photo 5: A *Symphony database form.*

C·I·A·R·C·I·A'S C·I·R·C·U·I·T C·E·L·L·A·R

A Musical Telephone Bell

Personalizing the sound of your telephone

BY STEVE CIARCIA

About a month ago, I was visiting an IC (integrated circuit) manufacturer that produces a line of communication and voice-synthesis chips, among others. I was there to get some firsthand information on some new chips that will be the heart of a low-cost Circuit Cellar voice-recognition project coming later this year.

The visit started like most business meetings I'm used to: it included a tour of the facility, discussions with the technical staff, and lunch. After returning from lunch, a group of us were standing in the corridor adjacent to a large divided office area deciding who should be part of the next meeting when a phone rang in the middle of the room. Everyone immediately stopped talking and looked toward their section of the office as the phone rang again.

They glanced at each other again as one said, "Is that my phone or yours?"

The consensus was, "It must be yours, it doesn't sound like mine."

I watched as all four started walking toward their offices. About halfway there, each one stopped dead and turned around. With a somewhat exasperated sigh, one of them said, "It was George's phone."

"It gets so frustrating. All the bells sound alike, and with the acoustics in here it's impossible to tell whose phone it is unless you're within 10 feet of it."

The others shared the same expression of annoyance as the discussion shifted from electronics-related topics to an area of more immediate concern: Why can't telephone manufacturers make different-sounding bells for phones? It would seem that in a free-enterprise system, adept at producing pet rocks and Cabbage Patch dolls, a custom telephone bell would be trivial.

While I didn't make any pledge to solve this problem, I recognized legitimate concerns and decided to intervene electronically. Therefore, projects on talking robots, automatic houses, and rainmaking machines will have to be put off for another month as I try to build a better mousetrap.

I hope that this month's project will solve the auditory confusion in an office or at least add a little spice to an otherwise boring telephone. Rather than just ring, the Circuit Cellar Whimsi-Bell plays the first few bars of 25 preselected tunes. Instead of hearing an annoying metallic clamor, you can be greeted by the theme to *Star Wars*, or perhaps you would prefer the "William Tell Overture."

Cleverly disguised in this whimsical project is a discussion of the telephone system. My intention is to help you understand characteristics and specifications that govern the telephone products you purchase or the telephone interfaces you might build. It also sets the stage for future Circuit Cellar projects dealing with telephone lines.

Reading between the lines, however, you'll soon realize that the central theme is not musical phones but rather ring detection and auto-answering the phone by computer. It may seem like a trivial consideration, but the environment is hostile and connection restrictions abound. First, a little about the phone system.

The Status Quo Telephone

Essentially, the characteristics of the telephone have been unchanged for 90 years. It originally used a carbon microphone and electromagnetic earphone with a capacitively coupled electromagnetic ringer triggered from a hand-turned magneto. Today's Western Electric phones incorporate many of the same materials, and new electronic phones merely simulate their archaic predecessors. For example, the characteristic impedance of the early Edison phones was 600 ohms, and today's electronic units must still abide by this specification.

The design and use of telephone equipment are dominated by line resistance. When you wish to answer or initiate a telephone call, the only requirement is to place a load across the

(continued)

Steve Ciarcia (pronounced "see-ARE-see-ah") is an electronics engineer and computer consultant with experience in process control, digital design, nuclear instrumentation, and product development. He is the author of several books about electronics. You can write to him at POB 582, Glastonbury, CT 06033.

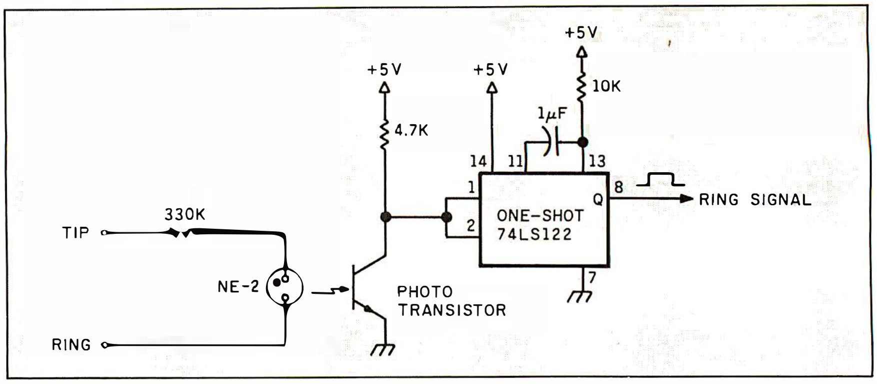


Figure 1: A *simple ring-detector circuit.*

phone lines (between tip and ring). The handset, or the data-access arrangement (DAA) in either your modem or your auto-dialer, will cause a DC current flow of approximately 25 to 30 milliamperes (mA). A current-sensing relay at the telephone company then signals the system that you are "off hook." If it is an outgoing call, you will receive a dial tone; if it is an incoming call, the ringing will stop and you will be connected to the incoming party.

The on-hook voltage between tip and ring of the telephone line is approximately 48 volts (V) DC. It is generally supplied by a battery from the telephone office and can range from 42.75 to 52.5 V. Tip and ring have nothing to do with the telephone ring itself; they refer to the plugs that the operators used to connect callers many years before automatic dial exchanges. The original system had large arrays of connection jacks with operators who would physically insert patch-cord jumpers between initiating and receiving calls. The two conductor patch cords made their electrical connection to the tip-and-ring portion of the plug. The tip connection was usually ground. (Anything designed for connection to the telephone line should not be polarity sensitive. Polarity is sometimes reversed, and 200-V test voltages are sometimes placed on the line.)

Once the line is captured, an off-hook situation exists and a dial tone will be heard in approximately a second. The dial tone actually consists of two tones: 350 Hz and 440 Hz. If you are contemplating building a computer-activated automatic dialer, a tone decoder should be incorporated to signal the computer that dialing can commence. It will also signal you when the call has terminated if it was not initiated at your end. (If you want to get elaborate, the awful sound that the phone company blares at you to attract your attention when you forget to hang up a phone consists of four tones: 1400 Hz, 2060 Hz, 2450 Hz, and 2600 Hz. Pulsed at a rate of 5 Hz, it is called the receiver off-hook tone.)

Dialing

Most residential telephones in this country still use mechanical pulse dialers. When you turn and release the telephone dial, the current in the telephone line through the off-hook relay is interrupted by the number of times indicated on the dial position. These dial pulses are issued at approximately 10 pulses per second (pps)—some exchanges will accept up to 21 pps—with about a 60/40 percent on-/off-hook duty cycle. Nine breaks in succession are interpreted as a "9" digit, and three breaks define a "3" digit.

The separation of digits is determined by the *interdigit time.* Any succession of pulses occurring more than 750 milliseconds (ms) after the last pulse are considered part of the next digit. For example, if you send five pulses at 10 pps, wait 200 ms and send three more pulses, the telephone company will interpret this as the single digit "8." If you had waited 750 ms between transmissions, they would have been interpreted as the two digits "5" and "3."

The latest innovation in the telephone system is Touch-Tone, the registered trademark for AT&T's dual-tone multifrequency (DTMF) communication. The pulses go only as far as the local exchange office. From there, and throughout the rest of the telephone system, DTMF tones are used to direct calls.

The advantages of DTMF are increased dialing speed and, more important, the ability to transmit data. DTMF tones are sent with a minimum duration of 50 ms and an interdigit time of 45 ms. A seven-digit number on a pulse-dial system would take 11 seconds versus less than 1 second for DTMF.

I won't dwell on DTMF because it is covered in detail in my "Build a Touch Tone Decoder for Remote Control" on page 42 of the December 1981 BYTE.

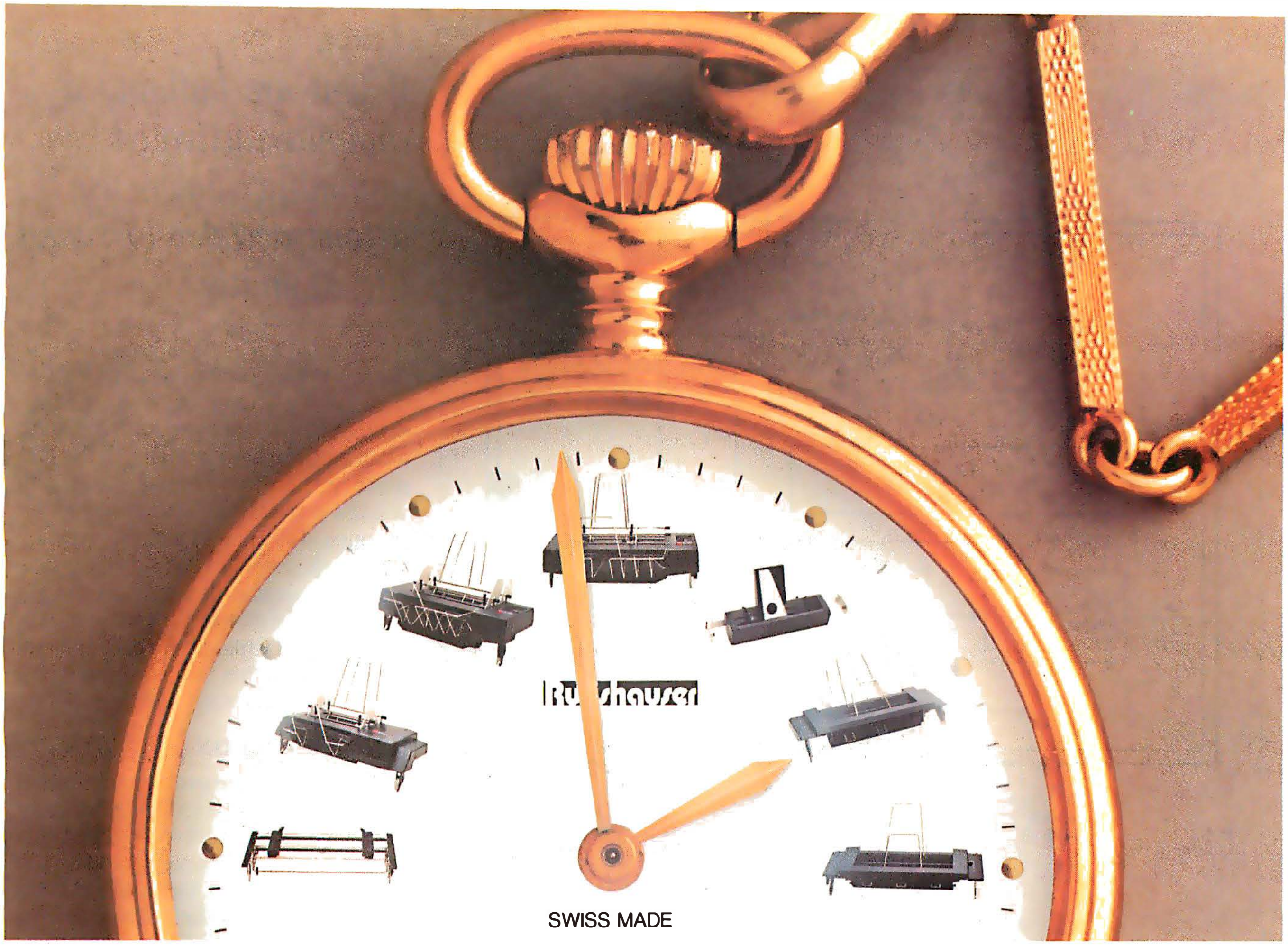
The Busy and Ring Signals

Again, if you intend to build an auto-dialer at some point, you should incorporate some means to recognize a busy signal. The busy signal consists of two tones, 440 Hz and 620 Hz, that are on for 0.5 second, then off for 0.5 second. Either the tones themselves can be recognized, or the unique 50/50 0.5-second duty cycle can be monitored.

When your telephone rings, it is the result of a high AC voltage being ap-
(continued)



Photo 1: *Whimsi-Bell attaches to the tip and ring wires in parallel with your phone.*



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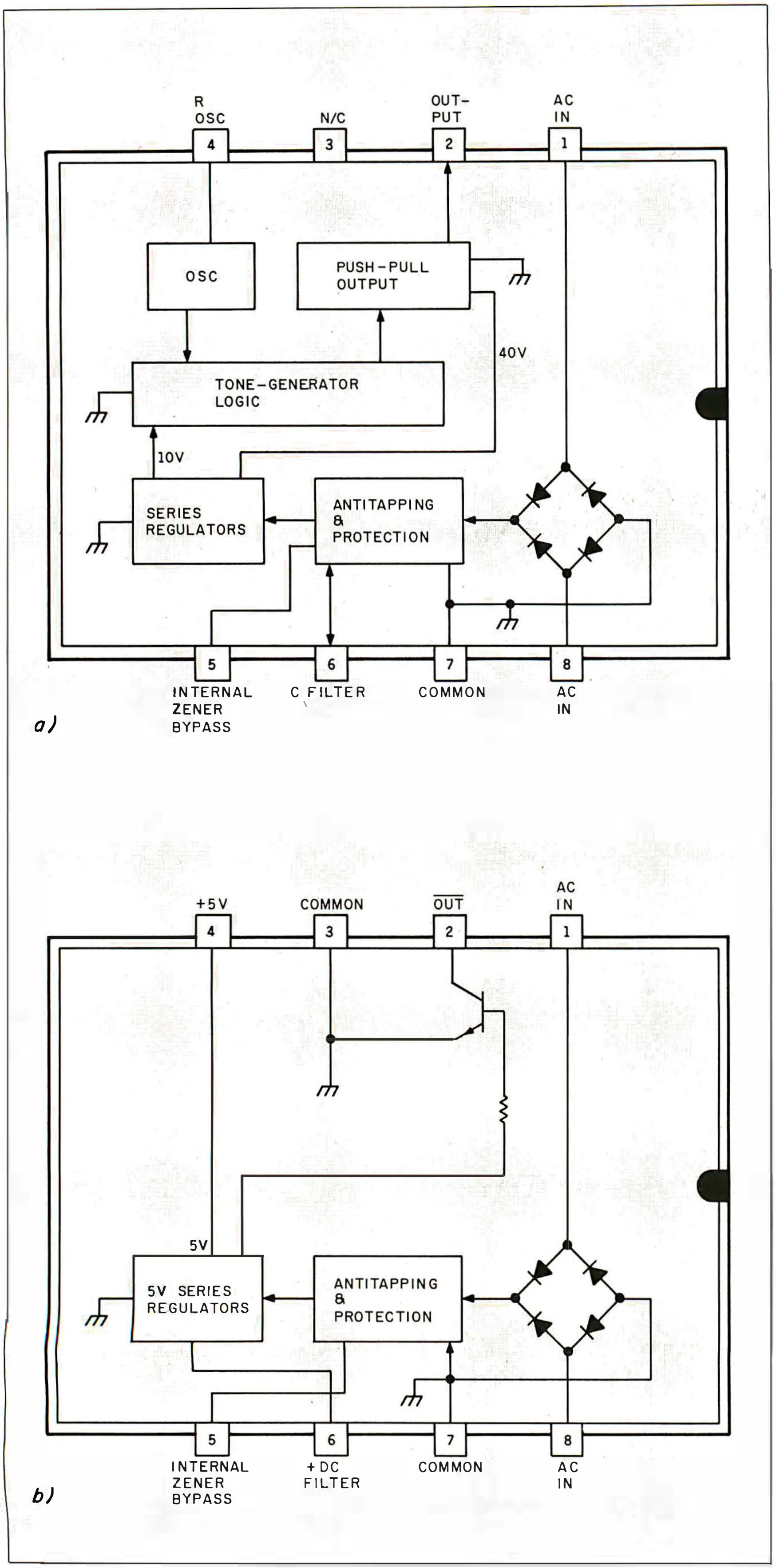


Figure 2: *Texas Instruments* CMOS *ring-detector chips.* (2*a*) *Block diagram of the* TCM1501A, TCM1505A, TCM1506A, *and* TCM1512A *versions.* (2*b*) *Block diagram of the* TCM1520A *version.*

If you are building a computer-activated automatic dialer, use a tone decoder to signal the computer.

plied to the telephone lines. The voltage is capacitively coupled to the electromagnetic bell. When you are initiating a call and you hear a ringing in the earpiece, you are not hearing the ringing voltage. Instead, you are hearing a pair of tones, 440 Hz and 480 Hz, used by the phone company for signaling. The on/off duty cycle depends on the exchange being dialed. When the ringing stops, it usually means the call has been completed or that you are irrevocably lost among the trunk lines.

Ring Detection

The solution to the problem described earlier is a ring detector. Rather than try to change all the bells in an office, it is a relatively simple matter to monitor the telephone line in parallel with the existing phone (with its bell turned low or off) and generate a different sound corresponding to the incoming ring signal. This new sound can be a buzzer, a slightly different bell, or an entirely new electronic signaling device. The actual alerting mechanism is secondary. It is all triggered by a circuit called a ring detector.

The incoming ring is the highest nontest voltage encountered on the telephone line. The normal on-hook condition is a high-impedance state with approximately 50 V DC between tip and ring. When the phone rings (usually 2 seconds on and 4 seconds off), it is because an additional 86 V AC of ringing voltage has been superimposed on the line. This 20 Hz ± 3 Hz signal is passed through a capacitor to the telephone bell, causing it to ring. While 86 V AC is nominal, the ringing voltage can vary from 65 to 130 V AC, and the DC component can appear as much as 70 V negative.

Because the ringing voltage is so different from other telephone signals, a ring detector is simple in theory to construct. The simplest ring-detector circuit (shown in figure 1) consists of a neon lamp and a phototransistor. Neon lamps such as the NE-2 have a turn-on threshold of about 65 V and therefore would respond only to the higher ringing

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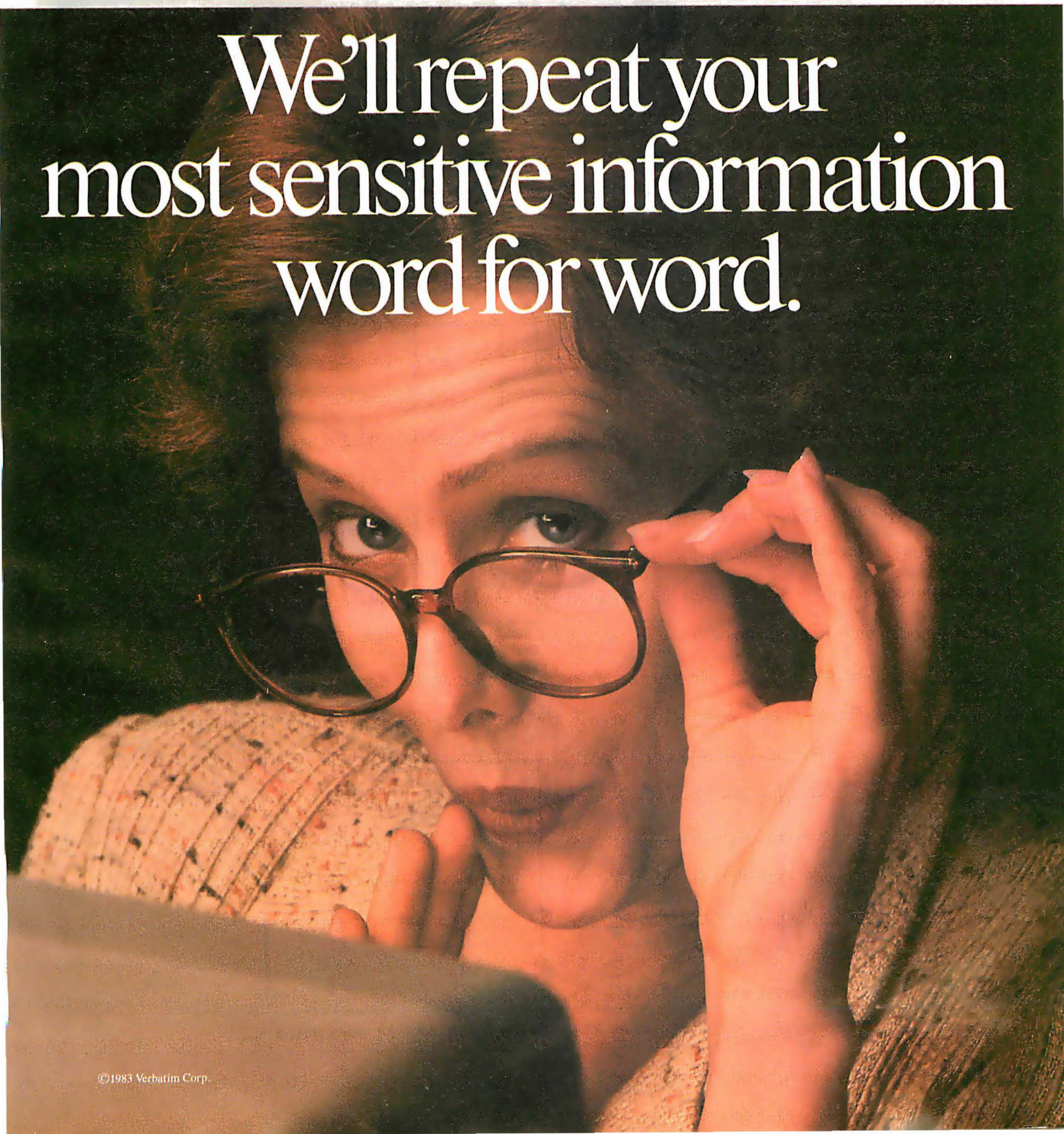


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voltages. When the neon lamp lights, it in turn causes the transistor to conduct and triggers the one-shot.

Variations on this circuit employing LED (light-emitting diode) optoisolators and level-detection circuits are available, but a price is paid for simplicity. The telephone line is not an ideal environment and contains many aberrations that can lead to false triggering by crude ring detectors. Just the action of going on hook or off hook (also called tapping) generates local line transients that are sufficient to cause a neon bulb or LED to fire. We can add more components or compensate for these peculiarities in our communications software, but, fortunately, alternatives exist.

Specially Designed Ring-Detector Chips

Texas Instruments produces a line of CMOS (complementary metal-oxide semiconductor) ring-detector chips that offer all the necessary features. (See figures 2a and 2b.)

The normal installation of the ring-detector chip uses a capacitor and a 2.2K-ohm resistor connected between the detector and the line. The network formed by the DC-blocking capacitor, current-limiting resistor, and full-wave bridge rectifier supplies power to the IC from the phone lines. The rectified AC signal is filtered by a 10-microfarad (μF) capacitor attached between pins 6 and 7. The value of this capacitor determines the minimum input voltage and turn-on time of the ring detector. It is also used to suppress response to dial tapping (tapping is a false triggering of the bell due to transient-producing pulses on the phone line, usually from rotary-dial phones).

In use, the ring-detector IC stays in standby mode until the incoming

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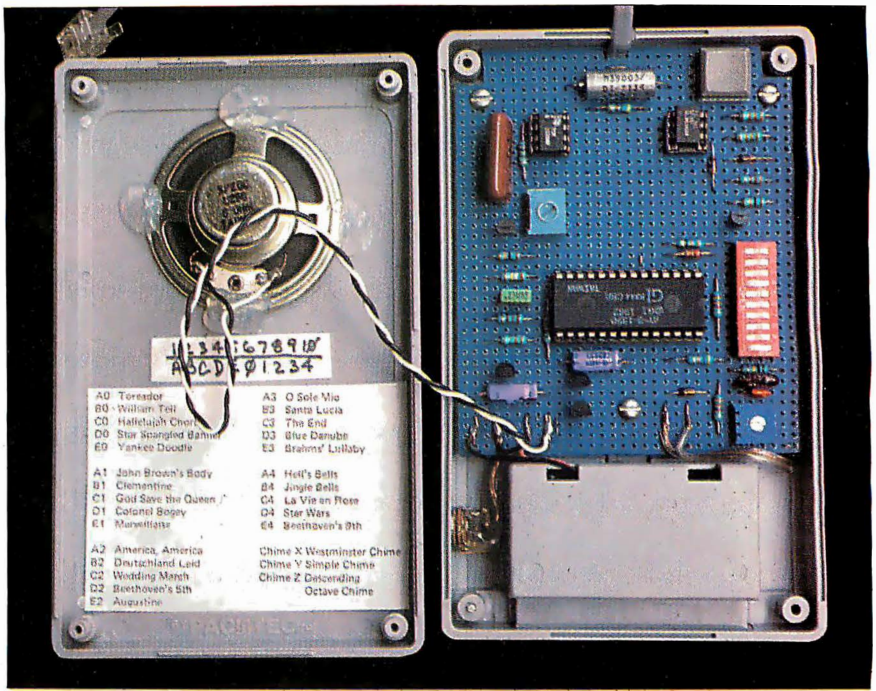


Photo 2: A *view inside the Whimsi-Bell prototype. The doorbell synthesizer chip can play 25 different tunes.*

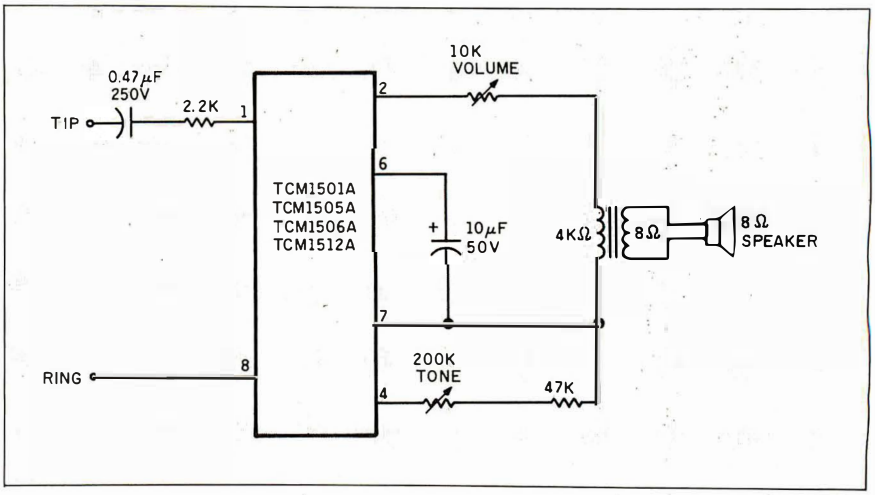


Figure 3: A *typical ring detector using the TI ring-detector chip.*

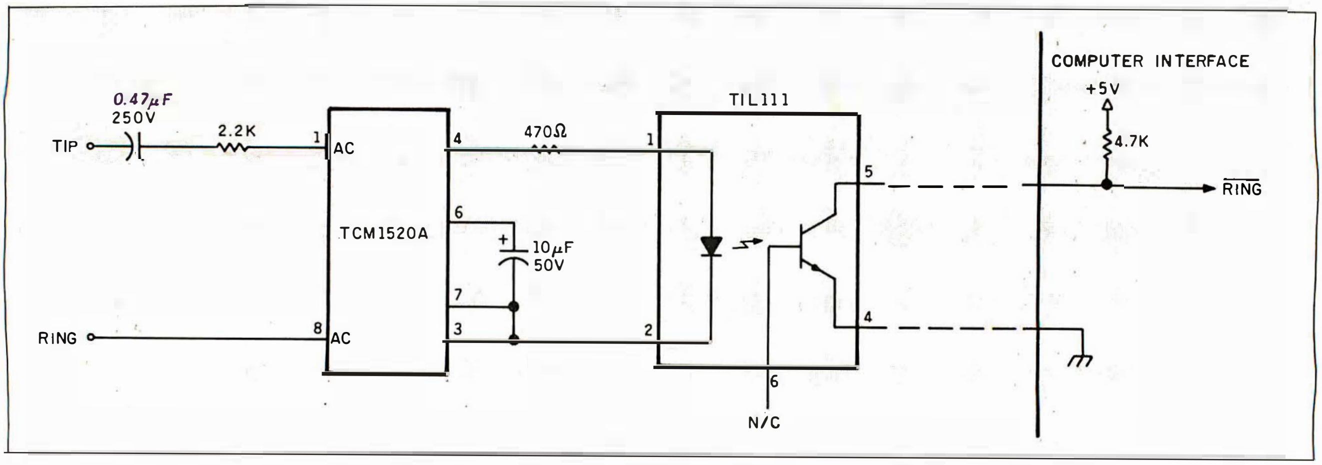


Figure 4: A *two-chip ring-detection circuit that provides an optoisolated ring-detector signal for your computer.*

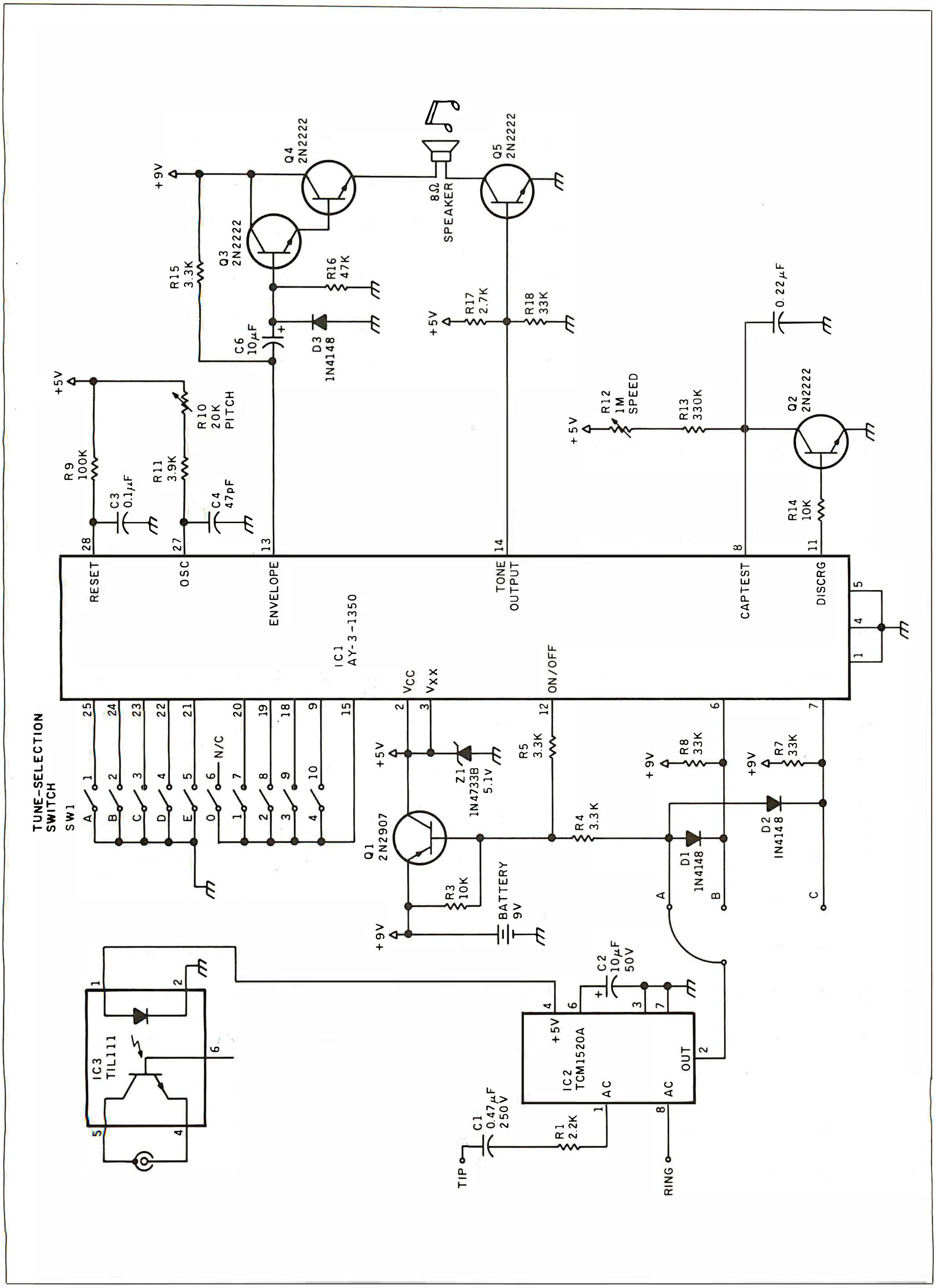


Figure 5: *The schematic of the Whimsi-Bell.*

voltage between pins 1 and 8 exceeds 8.9 V (remember, the off-hook condition is a DC voltage on the line, and the series DC-blocking capacitor prevents the ring detector from seeing this voltage). While in standby mode, the impedance is approximately 1 megohm.

When the voltage exceeds 8.9 V, the IC begins to conduct. This energy is not transferred to the load, however, until the input reaches 17 V. Should the input voltage continue to rise beyond a predetermined limit (a transient instead of a true bell signal), an internal high-current SCR (silicon-controlled rectifier) is triggered. The excess energy is dissipated in the 2.2K-ohm series resistor.

Two versions of the ring detectors are supplied by Texas Instruments. Models TCM1501A, TCM1505A, TCM1506A, and TCM1512A are detector tone drivers intended for use as electronic alternatives to the standard electromagnetic telephone bell. These chips incorporate an oscillator and a power audio-generator section to drive a piezoelectric transducer or speaker. Figure 3 demonstrates a typical circuit.

The TCM1520A is a ring detector only. It has a +5-V output signifying the ring signal rather than an audio output. The TCM1520A is best utilized in auto-answer modems. Figure 4 demonstrates a two-chip circuit that provides an optoisolated ring-detection signal that can be connected to a computer. When a ring signal is applied, the 10-μF capacitor charges until it passes the 17-V threshold. At that point, pin 4 outputs +5 V, which in turn drives the LED side of an optocoupler. The illuminated LED causes the transistor portion of the optocoupler to saturate, providing a low true signal to the computer. The computer, on recognizing a valid ring, gives

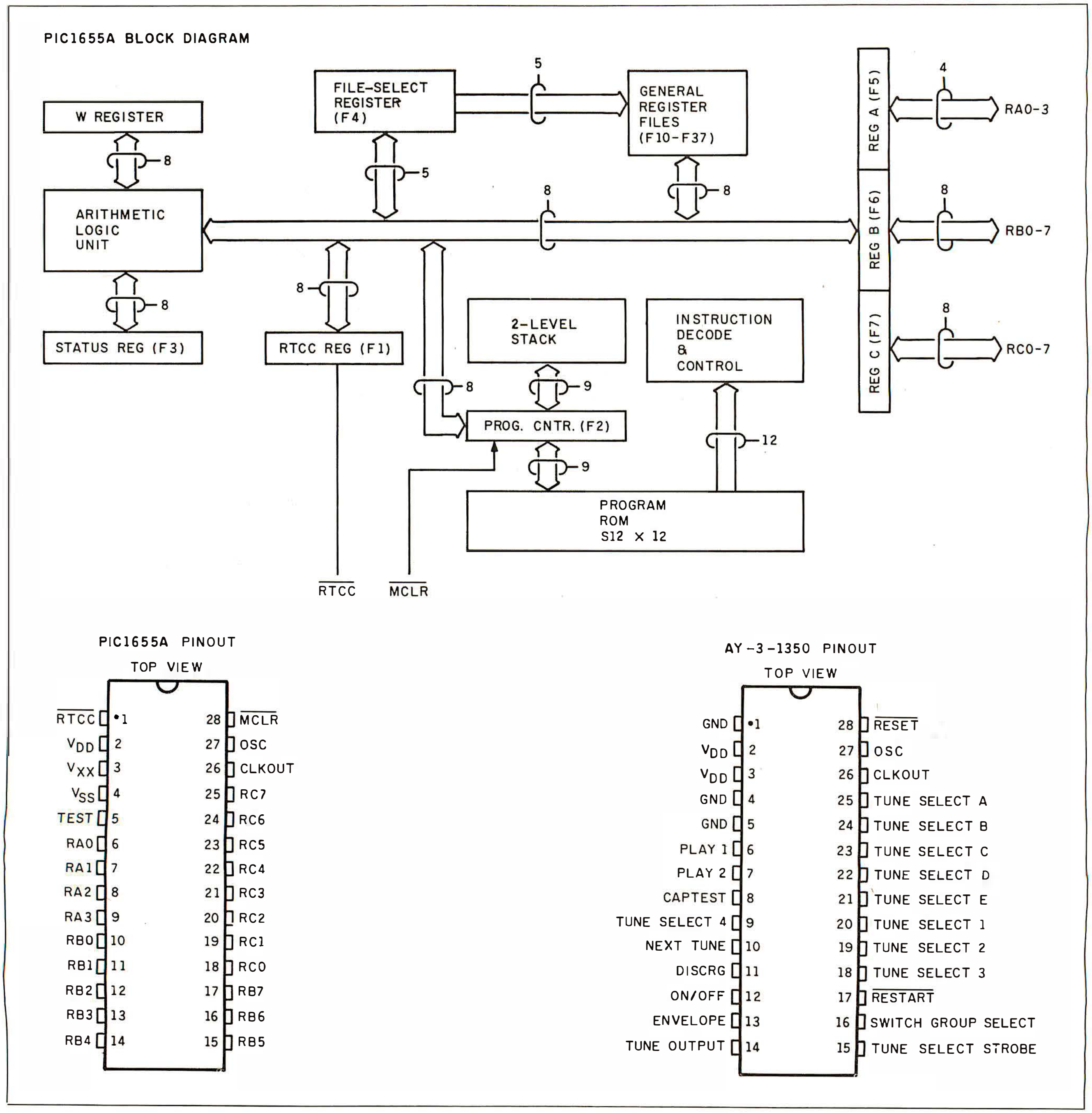


Figure 6: *Block diagram of the General Instrument AY-3-1350 tone synthesizer.*

an off-hook signal to the DAA or the modem to answer the phone.

Back to the Initial Problem

The office situation described earlier can be easily solved for one or two individuals with the one-chip circuit shown in figure 3. Here, a TCM1512A is used to drive a speaker. The circuit is connected in parallel to an existing phone that has had the bell disconnected or turned down. R1 sets the frequency of the "bell"; R2 sets its volume. When the phone rings, a different kind of bell is heard.

Such a circuit might be useful in some applications. Beyond a few installed in a large room, however, the same confusion would arise. Instead, a more varied signaling device must be employed.

A variety of alternatives comes to mind. Once you've detected the ring, virtually any triggerable event can occur. Initially, I thought it might be cute to attach a voice synthesizer or other equally nonstandard signaling device. However, I'd rather reserve voice synthesizers for more serious purposes. Instead, in the name of cost-effectiveness and mass production, I opted for Whimsi-Bell.

Whimsi-Bell

The Circuit Cellar Whimsi-Bell, shown in photos 1 and 2 and schematically diagramed in figure 5, combines a ring detector and a sophisticated microprocessor-controlled doorbell synthesizer. The phone is connected to the Whimsi-Bell through a Y-junction phone-line connector. When the phone rings, it plays the first few bars of one of 25 tunes or three chimes. The switch-selectable repertoire is listed in table 1. The circuit also includes an optoisolated output so you can connect the device to a computer as well.

The heart of Whimsi-Bell is the General Instrument AY-3-1350 tone synthesizer, which is actually a PIC 1655A 8-bit microcomputer that has been specifically mask-programmed as an electronic doorbell chime. Block-diagramed in figure 6, the PIC 1655A includes thirty-two 8-bit RAM (random-access read/write memory) registers, 512 by 12 bits of program ROM (read-only memory), an on-board oscillator and real-time clock, and 20 I/O (input/output) lines on a single chip. The chip runs on +5 V.

The Whimsi-Bell is powered by a 9-V battery and consumes virtually no power until it is triggered by a ring-detect signal from IC2. This signal turns power on to IC1 through Q1. Q1 is sustained for the musical period regardless of the length of the ring by the on/off signal, IC1 pin 12. The chip shuts itself off when it has concluded playing.

The ring-detect signal is attached to one of three points in the circuit (A, B, or C), depending upon the combination of tones you wish. All 25 tunes are accessible if the connection is to point A. The chimes are selected by opening all the selection switches and connecting the ring-detect input to one of the three input terminals. If A, it will play the Westminster chime; if B, it will play the simple chime; if C, it will play the descending-octave chime.

With the ring-detector connection at point A, where all 25 tunes are available, a particular tune is selected on the 10-position DIP (dual-inline package) switch SW1. SW1 positions 1 through 5 are assigned to selection codes A through E; SW1 positions 6 through 10 are assigned to selection codes 0 through 4. To select the *Star Wars* theme, D4, positions 4 and 10 would be closed (all others open). Every time the phone rings, that tune will be played.

The 25 tunes average nine notes each. The tunes are stored internally as a series of notes with a stop code following the last note in each tune. Each 8-bit note comprises a 5-bit pitch value and 3-bit duration. Two-and-a-half octaves of notes can be accommodated, with the durations ranging from a sixteenth note to a whole note. (I mention this only because the AY-3-1350 can be configured for external ROM should you care to play the entire "Star-Spangled Banner" when the phone rings. Contact General Instrument for an application note describing this procedure.)

There are two potentiometer adjustments. R10 varies the processor clock speed about 1 MHz to set the pitch. The other adjustment potentiometer, R12, varies the charging time on C7 to set the speed at which the notes are played.

The output of IC1 is a combination of signals. The actual tune output comes from pin 14, while pin 13 serves as an envelope generator to control the volume. A three-transistor amplifier directly drives an 8-ohm speaker.

In Conclusion

This month's project is a little less taxing than the 99-chip Trump Card from the last two months. Nonetheless, ring detection and the telephone system are important subjects for discussion.

While I don't think everyone is going to want a Whimsi-Bell attached to their phone, all the people who have heard my prototype have been amused enough to want one, if only as a unique conversation piece. More important, I'm encouraged by all the experimenters who have built one of the Circuit Cellar modem projects and see this as a means to add auto-answering.

Table 1: *Tunes and switch settings for the Whimsi-Bell.*

Switch	Tune	Switch	Tune
A0	Toreador	A3	O Sole Mio
B0	William Tell	B3	Santa Lucia
C0	Hallelujah Chorus	C3	The End
D0	Star-Spangled Banner	D3	Blue Danube
E0	Yankee Doodle	E3	Brahm's Lullaby
A1	John Brown's Body	A4	Hell's Bells
B1	Clementine	B4	Jingle Bells
C1	God Save the Queen	C4	La Vie en Rose
D1	Colonel Bogey	D4	Star Wars
E1	Marseillaise	E4	Beethoven's Ninth
A2	America, America		
B2	Deutschland Leid		
C2	Wedding March		
D2	Beethoven's Fifth		
E2	Augustine		

Next Month

I'll be answering some of the questions I've been asked about my previous projects. In September, I'll present the Circuit Cellar AC Power Monitor. ■

Editor's Note: Steve often refers to previous Circuit Cellar Articles. Most of these past articles are available in reprint books from BYTE Books, McGraw-Hill Book Co., POB 400, *Hightstown,* NJ 08250.

Ciarcia's Circuit Cellar, Volume I covers articles that appeared in BYTE from September 1977 through November 1978. *Volume* II covers December 1978 through June 1980. *Volume* III covers July 1980 through December 1981. *Volume* IV covers January 1982 through June 1983.

To receive a complete list of Ciarcia's Circuit Cellar project kits, circle 100 on the reader-service inquiry card at the back of the magazine.

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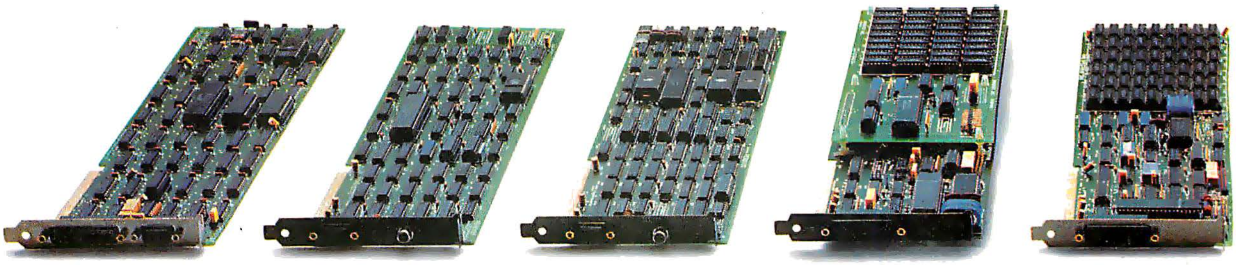
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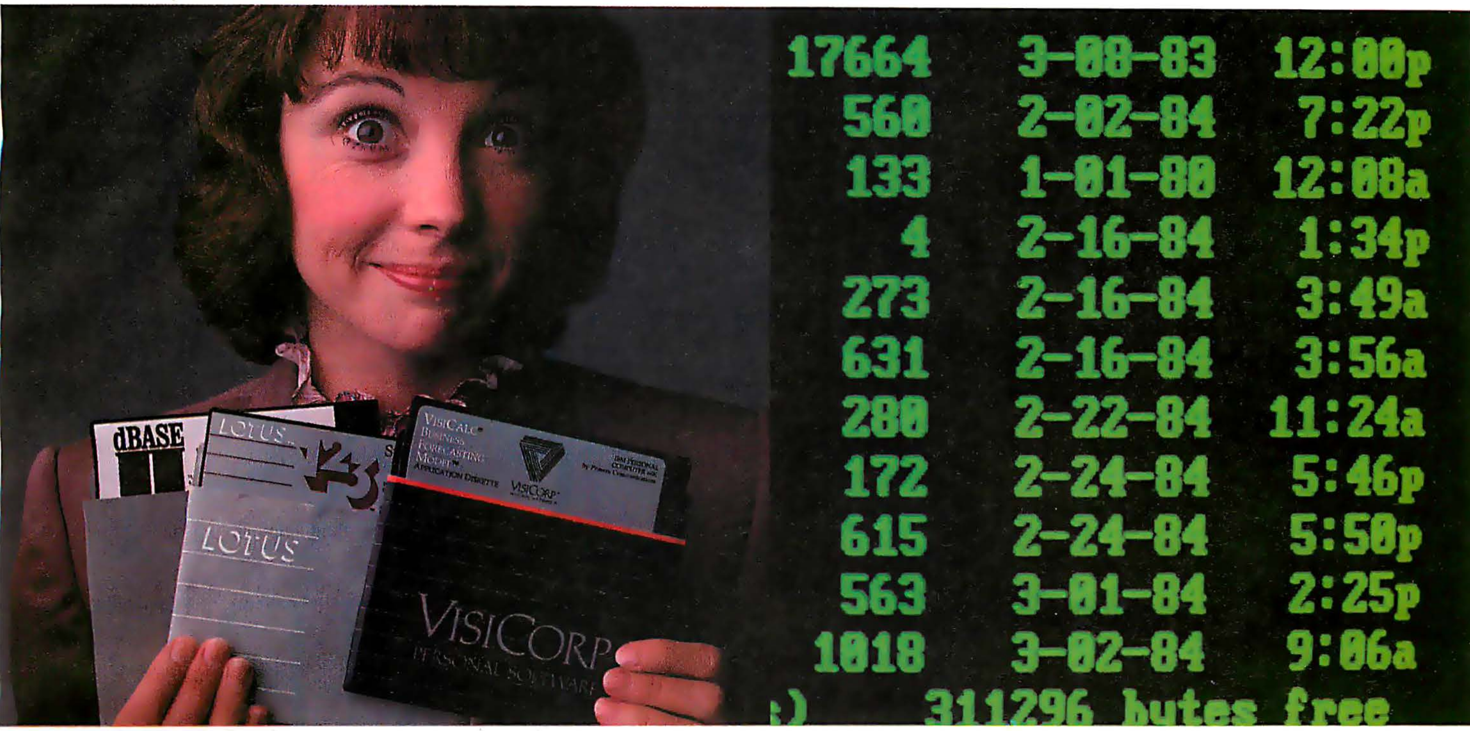
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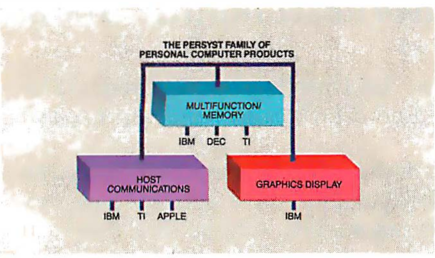


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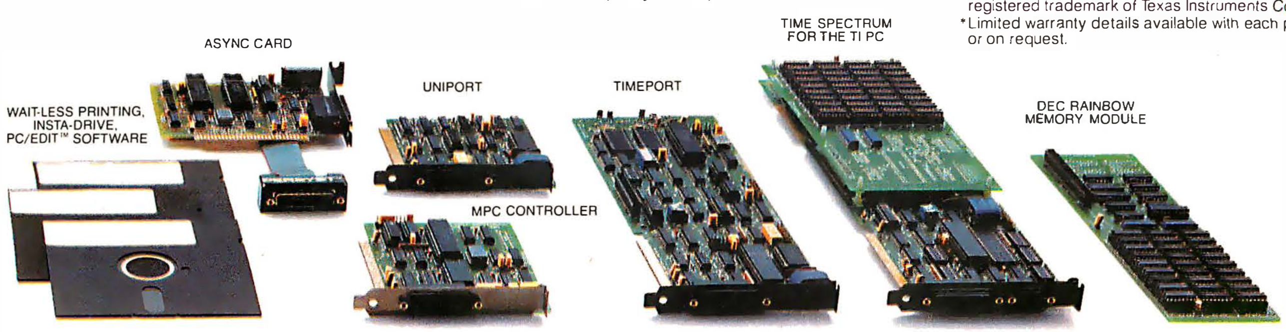
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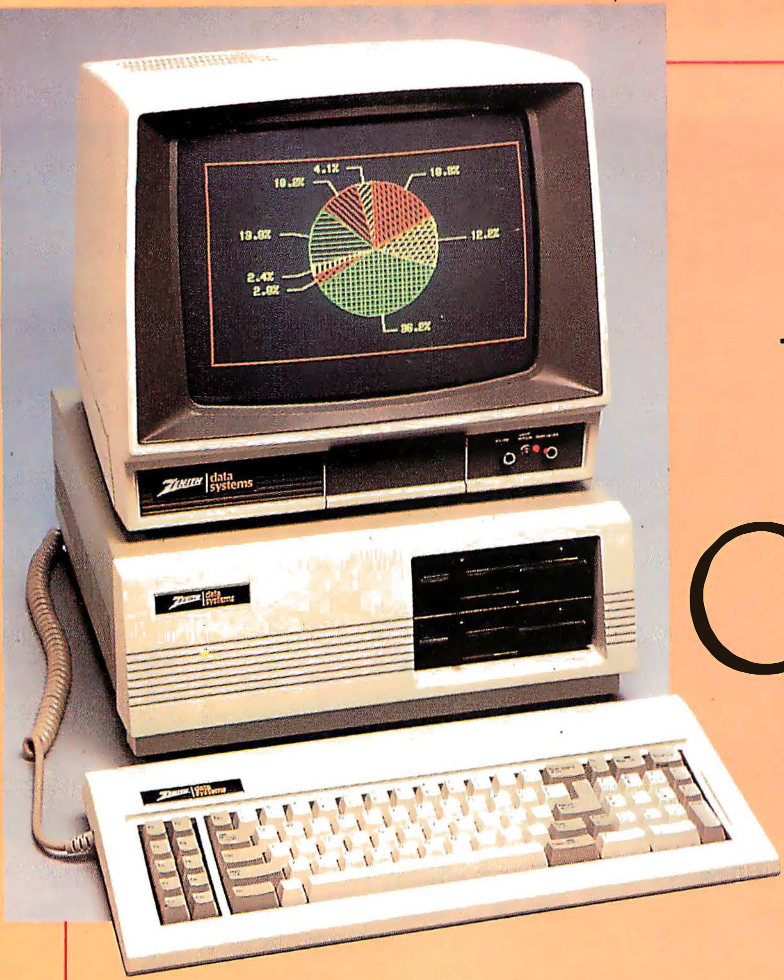
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THE WEST COAST FAIRE

BY JERRY POURNELLE

The lord of the Manor visits his favorite computer show

The West Coast Computer Faire is my favorite computer show; how can a big publishing company like Prentice-Hall put it on the way Jim Warren did?

Of course it can't and it didn't, but in justice, Jim Warren wouldn't have been able to keep it up, either. For better or worse, the micro industry has changed. Oh, sure, there are still some pretty good products for sale in the little booths along the walls, but there were fewer than in the old days for the simple reason that the big outfits also have a lot of incredible new stuff, and it's a lot harder for a newcomer to compete.

This Faire was to be four days long, with Wednesday as set-up day. I went up Tuesday evening to spend some time with some of the BYTE editors. Wednesday morning I went down to the Faire office. The press room wasn't set up, but I hadn't expected it to be. I went to exhibitor registration and asked for a press badge.

They'd never heard of press badges. Hah, thought I. Changes. Warren always let us get in early. Set-up day is a good time for interviews and private demonstrations before the crowds arrive. These people don't understand that. Ruining the Faire, they are...

Someone sent for David Sudkin. He listened for a moment, said "Sure!" and produced a big red "TEMPORARY" badge. End of problem. I wandered in to talk to people.

As usual, set-up day is a study in controlled chaos. The big companies like MicroPro, Apple, and IBM have professional set-up crews working with the local San Francisco exposition services people. The smaller outfits are on their own.

At least they used to be. This year the unionized exposition troops were greedier than usual. In the past they'd let a small booth owner carry his own stuff; this year they socked *everyone* for a couple of hundred bucks to let them unload their trucks. It's a good racket: $200 to carry 10 boxes a hundred feet or so.

Eating the Seed Corn

It's also a stupid racket, like eating the seed corn, because some of the smaller outfits won't come back. Indeed, all day Wednesday the talk among exhibitors was that it was time to get the Faire out of San Francisco and into a friendlier city. More than half the exhibitors I talked with swore they wouldn't be back next year.

There were a lot fewer, anyway. That is: there was a lot of space rented. Not quite as much as last year: no one was on the garbage-collection platform, and the

chair-storage area, otherwise known as the Black Hole of Calcutta, hadn't been rented, but everything else had been, including the two side halls that used to hold seminars and speeches.

Instead of lots of small exhibits, there were fewer, but much larger, setups. Three of the biggest were in a row: IBM, Apple, and Digital Equipment Corporation (DEC).

Wednesday ended with the traditional "after set-up" party thrown by *Compute!* magazine. As usual, there were more press people than exhibitors snarfing up the hors d'oeuvres and free beer. We also noted that there was no exhibitors' lounge: that location had been rented by Apple to let people get hands-on experience with Macintosh, or maybe it was IBM doing the same thing with PC and PCjr. The party was in the concession area—and unlike last year, there were no chairs and tables, just food service counters, with booths across a narrow aisle from them. I pitied the people who had those booths.

When I left on Wednesday night, it was a scene of pure chaos. On Thursday morning, the miracle had happened again: everything was set up. I headed upstairs to the Workman and Associates booth for coffee.

No coffee. The union people had not only forced Barry to pay for work he hadn't needed, but they'd lost the box containing vital parts to the coffee maker. Mornings are not endurable without coffee; you might as well sack a city. Eventually I found some in the press room, but by then I was thoroughly prepared to make this my last Faire.

Enter the Populace

At 11:00 the doors opened and the crowds came in.

There were quite a few people. Not as many as we had on the first day last year, but a respectable number—and this was, after all, Thursday. Last year the Faire was only three days and opened on Friday.

They were interested people, too. Fewer hackers—but a lot of *customers*. As I made my hurried cruise through the aisles, it seemed that more people were buying things. Barry Workman confirmed that when I got upstairs. There were a lot more serious customers.

All the presentations were well attended, too. The panels for hackers and hobbyists had plenty of those, but the panels for newcomers and users had crowds, too. The "All Star" speeches, which featured Bill Gates, Gary Kildall, Bill Godbout, Steve Wozniak, Adam Osborne, and, somehow inserted into this rarified atmosphere, me, were all crowded with attentive people who asked intelligent questions. This was a serious crowd.

By Thursday night it was pretty well confirmed: there were some glitches and justified complaints, but the new staff was trying hard to take care of the problems. This was a *different* Faire, but it was still a good one.

Barry Workman sells a line of CP/M software, including WRITE, my favorite text editor. He had more sales the first two days than he did during the entire Faire last year. Others report the same, and that's not just software vendors. The people at the Priority One booth had lots of business, and when they announced a big sale on CompuPro 40-megabyte hard disks (like mine), there was something approaching a feeding frenzy. Even vendors of computer furniture reported big sales.

I expect there are several reasons for this. The state of the economy didn't hurt, of course. More important, though, more people have microcomputers, so they're ready to buy software and accessories. Whatever the reason, they were buying, and by Saturday night I could tell the exhibitors by their satisfied smiles.

Some Hits

There wasn't much new and exciting stuff. The best hardware wasn't at the Faire at all: Richard Ohran, of Modula Computers Inc., was on a panel about Modula-2 with me. He brought a couple of the U.S.-built modifications of Niklaus Wirth's Lilith computer, but they could only be seen in his hotel room. Naturally, I went. It's wonderful. It has fabulous graphics capability, better than Macintosh or even the (alas, late and lamented) Diser Modula Engine, except that the Modula Computer Lilith has a Winchester hard disk and a 5¼-inch floppy disk—much nicer than the goofy Honeywell-Bull "washing machine" hard-disk cartridge that came with the Diser.

The Modula-2 panel was interesting, if a bit frustrating. Panelists were Ohran, Tony Gorrengourt of Logitech, John M. Craig, formerly of Diser and now with Ohran's company, and Joel McCormick of Volition Systems. I'd been asked to be chairman; since I was going to the panel anyway, this gave me a good seat, although I didn't have much to say. We had a good crowd, every seat taken; there's a lot of interest in Modula-2.

Tony Gorrengourt led off with a neat presentation on the philosophy of Modula-2. Then John Craig described the U.S. version of the Lilith machine. Joel McCormick promised that Volition Systems would get the 68000 native code Modula-2 compiler finished Real Soon Now. Richard Ohran described the public-domain Modula Research Institute compiler (for the IBM PC), which is available for $40. (Useful if you're interested in Modula-2; alas, not really in shape for doing much practical programming.)

We were also able to announce that in early March a group met in Zurich to form the International Modula Users' Association, and we even agreed on some standards for the language and library modules. With any luck, we won't have a proliferation of dialects and libraries the way things went for Pascal.

Turbo!

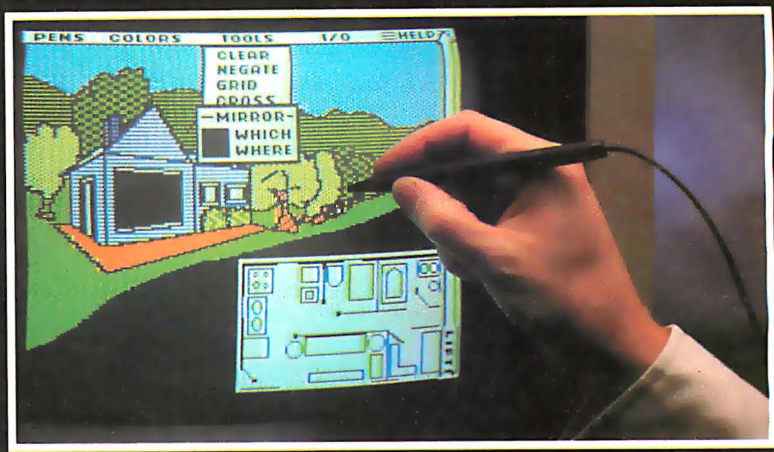
One very hot item was Borland International's Turbo Pascal, which was on a show special at $46.95, not much under the standard $49.95, but low enough to attract

(continued on page 376)

Jerry Pournelle holds a doctorate in psychology and is a science-fiction writer who also earns a comfortable living writing about computers present and future.

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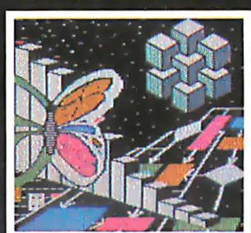
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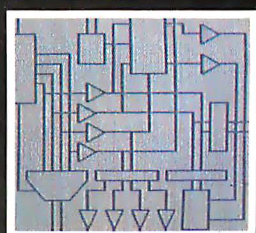
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PART 2

TOOL BUILDING IN ADA

BY SABINA H. SAIB

Sabina H. Saib (1500 Holiday Hill, Goleta, CA 93117) is a member of the Aeronautical Operations Group at General Research Corp. Dr. Saib is the author of an Ada textbook to be published by Holt, Rinehart & Winston and co-author of a tutorial published by the IEEE Computer Society.

THIS IS THE SECOND PART of the two-part Ada language primer that began in last month's issue of BYTE. The first part was an introduction to the fundamental structures of Ada. In part 2, I'll cover more advanced programming techniques and explore Janus Ada, a partial Ada for microcomputers.

This primer is closely modeled on "A C Language Primer" by James Joyce, published in BYTE in August and September of 1983.

One of the reasons Ada may become very popular is its ability to package subprograms. The packaging of functions and operators enables programmers to write clean, expressive programs, as in this example:

```
--copyc. ada
--Copy input to output
with text_io; use text _io;
procedure copy is
  c : character;
begin
  loop
    get(c);
    put(c);
    if end_of_line then
      new_line;
    end if;
  end loop;
exception
    when end_error = > null;
end copy;
```

This program copies characters until an end-of-file condition is reached. **end_of_file** is one of many predefined functions available in the **text_io** package. (See "An Ada Language Primer, Part 1" for an introduction to Ada and the **text_io** package.)

Such definitions make a program far more readable than using tests such as **while c < > char$(26) loop** or other obscure means for end of file. By stating before the program that we want to access the package **text_io**, we can use these predefined procedures and functions.

A proper Ada program is organized into packages that normally contain data, user-defined types, and subprograms. There is also a **main** procedure, which may be called **main** or some name meaningful to the application. In our example, our main program's name is **copy**. As we saw in part 1 of this primer, one organizational scheme divides up an Ada program into subprograms that are called by the main program.

In part 2, we will cover the concept of tool building—code that can be used as general-purpose subprograms.

STRINGS

Ada contains a built-in procedure, in the package **text_io**, to let an entire line of text read into the computer. To demonstrate the elegance of building tools from simpler subprograms, however, we will define such a program based on the primitive procedure **get** for characters. With this procedure, you can build a procedure that reads a line of input and package it as a procedure, named **get_my_line** in a package named **my_package**. Then you can use the procedure whenever the need arises. The next two examples develop a slightly modified version of the **get_line** function found on page 26 of Kernighan and Ritchie's book *The C Programming Language* (Englewood Cliffs, NJ: Prentice-Hall, 1978); also see "A C Language Primer, Part 2: Tool Building in C" by James Joyce (September 1983 BYTE).

The first example focuses on strings, which are defined as an array of characters in Ada. The program is written as a main program named **get_line**.

```
--getline.ada
--input and display a line
with text_io; use text_io;
procedure get_line is
  limit   : constant := 80;              --A
  subtype index_type is
          integer range 0..limit;        --B
  index : index_type := 0;
  c       : character;
  line    : string (1..limit)            --C
          := (others = > '');            --D
begin
  for i in 1..limit loop                 --E
  begin --set exception block            --F
    get (c);
    index := i;
    line (index) := c;
    if end_of_line then                  --G
      index := i + 1;
      line (index) := ascii.cr;
      exit;
    end if;
  exception
    -exit from loop when end of file
    when end_error = >
      index := index + 1;
      line (index) := ascii.cr;
      exit;
  end; --for exception block
  end loop;
  --line formed, display it
  for i in 1..index loop                 --H
    put (line(i));
  end loop;
end get_line;
```

The example begins by defining a compile time constant named **limit**, which is set to 80 in line A. This value is used in the definition of a subtype in line B and in the definition of an **object** in line C. Line B defines an integer subtype for variables that have values between 0 and **limit**. Such a variable is **index**, which is used to keep track of how many characters are read into the object named **line**.

(continued)

line is defined in line C as a string of length **limit**. It is initially set to all blanks by the assignment to **(others => ' ')** in line D. This expression is called an *aggregate*. Aggregates are very useful in setting arrays (or parts of arrays) to some chosen value. This line also demonstrates the power of Ada initialization expressions.

The other declaration in this program is for the object named **c**, a character variable used in calls to the primitive procedure **get**.

The executable part of the program consists of two loops. One loop inputs the data character by character and the other loop displays the characters in a line. Line E defines a **for** loop, which has a loop parameter i that can step between 1 and **limit**. The loop has two conditions that can result in an early exit. In line F, a block is set up so that an end-of-file exception causes the loop to exit. In line G, a test is made if an **end_of_line** has been read. In either case, a carriage return is saved in the next character position. The example shows that there are also predefined character names for certain characters; for example, **ascii.cr** signifies a carriage return. In fact, all ASCII (American National Standard Code for Information Interchange) characters can be referred to by their symbolic values or by their designated names, such as **lf** for line feed and **del** for delete.

In analyzing the first loop, it is apparent that there are three conditions that can stop the loop:

- the loop parameter i has reached **limit**
- an end-of-file marker has been read
- a carriage return has been read

Line H defines the **for** loop used to display the line by letting the loop parameter **i** take on the values between 1 and **index**. For each value of i, the character in **line(i)** is displayed with the primitive procedure **put**.

After writing a program such as the preceding example, you should take some time to rethink the problem. Where possible, it is better to avoid the **exit** statement: it adds paths to the program, resulting in an unstructured program. The example that follows is written in a better style and performs essentially the same function.

```
--getline2.ada
--input and display a line
with text_io; use text_io;
procedure get_line is
  limit  : constant := 80;                              --A
  subtype index_type is
          integer range 0..limit;                       --B
  index : index_type := 0;
  c      : character := ' ';
  line   : string (1..limit)
          := (others => ' ');                           --C
begin
  while index < limit and
        c /= ascii.cr and
        c /= ascii.eot loop                             --D
   begin --set exception block
    get (c);
    index := index + 1;
    line (index) := c;
    if end_of_line then
      c := ascii.cr;
      index := index + 1;
      line (index) := ascii.cr;
    end if;
   exception
    --set character when end of file
    when end_error =>
      c := ascii.eot;
      index := index + 1;
      line (index) := ascii.cr;
   end; --for exception block
   end loop;
   --line formed, display it
   for i in 1..Index loop                               --E
     put (line(i));
   end loop;
end get_line;
```

The major difference between the two programs is the **while** loop for inputting the data. The **while** statement explicitly states all of the conditions for staying in the loop. This is preferable to searching for **exit** statements. If all conditions for staying in the loop are satisfied, the program increments the **index** variable, stores the character, and reads another character.

Another method uses a special character to designate the end of the string. This is done in the C language and could be done in Ada as well, but such conventions do not yet exist in Ada. The following example takes such an approach by using a carriage return to end the string. The example illustrates the use of strings as arguments to a subprogram. The code in the inner loops of the previous example are packaged in procedures named **get_my_line** and **put_my_line**.

```
--mypackage.ada
--subprograms to input and display a line
with text_io; use text_io;
package my_package is
  limit : constant := 80;
  subtype index_type is
          integer range 0..limit;

  --to read a line into a string
  procedure get_my_line (line : out string;
          length : out index_type;
  --to display a line
  procedure put_my_line (line : in string);
end my_package;

package body my_package is
  --to read a line into a string
  procedure get_my_line (line : out string;
          length : out index_type) is
    index : index_type := 0;
    c      : character := ' ';
    begin
      line := (1..line'last => ' ');
      while index < limit and
            c /= ascii.cr and
            c /= ascii.eot loop
      begin --set exception block
        get (c);
        index := index + 1;
        line (index) := c;
        if end_of_line then
          c := ascii.cr;
          index := index + 1;
          line (index) := ascii.cr;
        end if;
      exception
```

```
         --set character when end of file
         when end_error = >
            c := ascii.eot;
            index := index + 1;
            line (index) := ascii.cr;
      end; --for exception block
      end loop;
      length := index;
   end get_my_line;

   --to display a line
   procedure put_my_line (line : in string) is
      index : index_type := 1;
   begin
      while line (index) /= ascii.cr and
            index < limit loop
         put (line(index));
         index := index + 1;
      end loop;
      new_line;
   end put_my_line;
end my_package;

with text_io, my_package;
use text_io, my_ package;
procedure main is
   my_string : string (1..limit);
   all_done  : constant := 1;
   length    : index_type := 0;
begin
   put (" Program to copy lines from input to output ");
   new_line;
   put (" Terminate program by entering just ");
   put (" a carriage return.");
   new_line;
   while length /= all_done loop
      get_my_line (my_string, length);
      put_my_line (my_string);
   end loop;
end main;
```

In packaging the subprograms, we first write a *package specification*, which contains any types appropriate to the package and specifications for the subprograms contained in the package. Our package, named **my_package**, has one type, the definition for **index_type**; one constant, **limit**, to define the string length; and two subprograms. **get_my_line** is defined as a procedure with two parameters: one for the string and one for the length of the line. **put_my_line** is defined as a procedure with one parameter. We need not specify the length of the string passed as a parameter to each subprogram. We need only specify the type of the parameter as string and whether the subprogram uses it as an input or an output.

Simple parameters in Ada are passed not as addresses but as values. This protects against side effects in subprograms. Furthermore, parameters declared as "in" cannot be assigned a value in a subprogram. For efficiency, when an array is passed as a parameter, the address of the array may be passed instead of the value of the contents of the array.

To compile and execute the program on a VAX computer with the New York University (NYU) Ada/Ed compiler, we type **$ ada mypackage**. After starting execution, the program prompts us with

```
Begin Ada execution
Program to copy lines from input to output
Terminate program by entering just a carriage return.
>
```

If we type **This is some normal data.** followed by a carriage return or an end-of-file signal (which is normally Control-Z), we will see

```
>This is some normal data.
This is some normal data.
>^Z

  Execution complete
  Execution time: 185 seconds
  I-code statements executed: 718

$
```

Two lines appear as a result of the program execution. The first echoes your input from the operating system. The second is from the combination of **get_my_line** and **put_my_line**. The input was terminated with a Control-Z, which appears as **^Z**. The actual execution time shows that this is an experimental compiler not intended to execute "real" programs. This compiler was produced to demonstrate that an Ada compiler could be written with a reasonable amount of effort and to provide an early experimental compiler for researchers investigating Ada. Near the end of this article, there is a section that shows the time taken to execute the same program on an IBM Personal Computer using one of the partial compilers. This example provides a better indication of the time that can be expected with one of the early partial compilers.

Case Statements

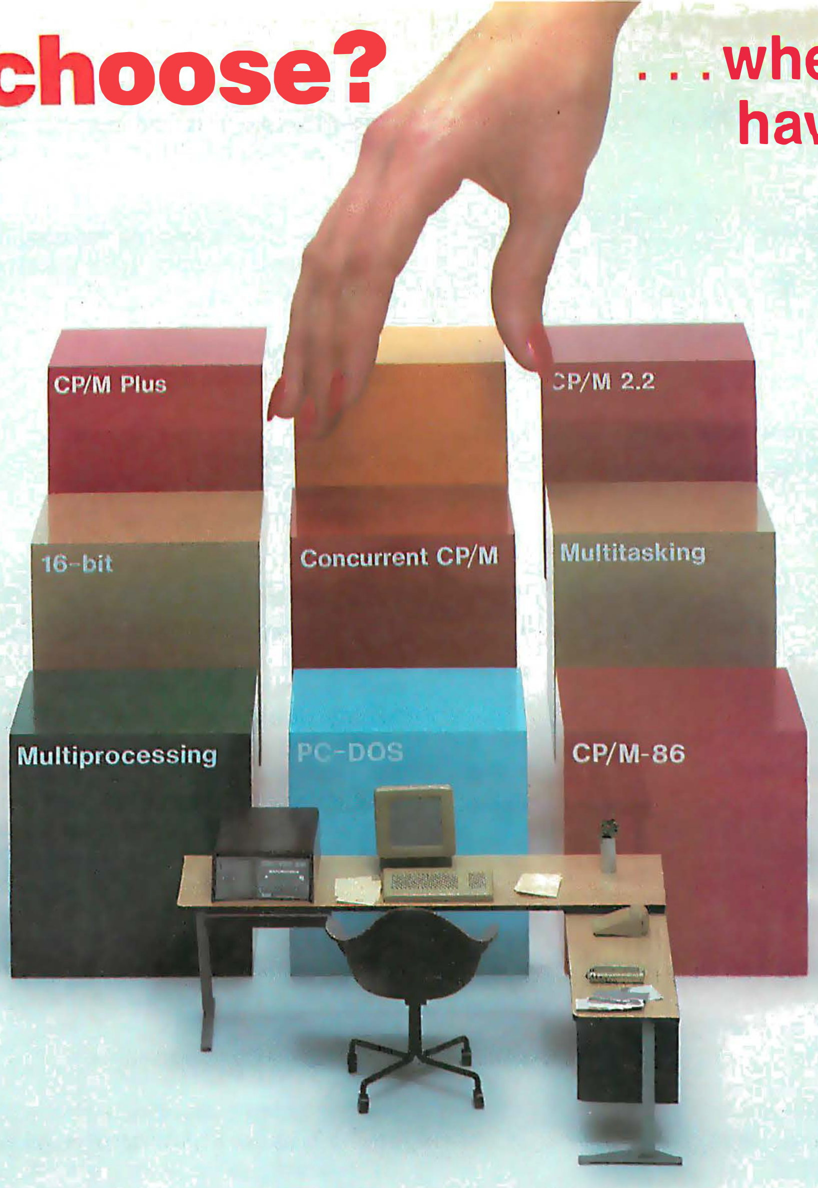
The last control structure we'll discuss is the *case statement*, which lets us use a multiway decision via an elegant construct. The following example of a simple, suggestive help system for NYU Ada/Ed offers an introduction to case statements.

```
--case.ada
--Demonstrate case statement
with text_io; use text_io;
package help_package is
   --send instructions to display
   procedure greet;
   --receive response
   --filtering out tabs, blanks, and carriage returns
   procedure get_response (c : out character);
   --show help messages
   type help_topic_type is (ada_help, syntax_help,
      library_help, error_help);
   procedure help (help_topic : help_topic_type);
end help_package;

package body help_package is
   --send instructions to display
   procedure greet is
   begin
      put (" On line help for Ada programmers ");
      new_line; new_line;
      put (" Type                  For help about              ");
      new_line;
      put ("--------------------------------------------------------------");
      new_line;
```

(continued on page 386)

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KERMIT:
A FILE-TRANSFER PROTOCOL FOR UNIVERSITIES

PART 2: STATES AND TRANSITIONS, HEURISTIC RULES, AND EXAMPLES

BY FRANK DA CRUZ AND BILL CATCHINGS

THE KERMIT file-transfer protocol was developed at Columbia University primarily for downloading files from mainframes to microcomputers, but it has evolved into a comprehensive communication system for transferring data between numerous types of computers. Kermit is inexpensive and reliable, uses RS-232C asynchronous serial communications to exchange packets of information, and has error checking for reliable transmission of files and information.

By defining a common subset of different computers' communication capabilities, Kermit sets up the minimum standards for communication between two systems. Numerous advanced features and options make Kermit powerful and flexible; many parameters can be changed, and it can even be set up as a simple network file server. Kermit is a portable protocol that is compatible with and has already been implemented on many operating systems and brands of computers.

In part 1 we covered the design considerations and specifications for the Kermit protocol, from the different ways systems handle files and information to the encoding, error detection, and layout for the packets of information. This concluding part presents the states and transitions that take place in the Send and Receive File modes, rules that improve the performance and reliability of Kermit, examples of packets and a transfer session, the user interface, and future developments for Kermit.

> **KERMIT OFF CAMPUS**
>
> **Although best known in educational circles, Kermit is equally suited to use by corporations, government agencies, and other organizations using a variety of large and small computers.**

Frank da Cruz is the manager of systems integration at the Columbia University Center for Computing Activities (612 West 115th St., New York, NY 10025) *and is also planning the university's move toward personal computing in the coming years. Bill Catchings is the chief systems programmer of the file-transfer protocol and its principal designer.*

PROTOCOL STATES AND TRANSITIONS

The Kermit protocol can be described as a set of states and a set of transitions that define, for a given event, what action to take and what new state to change to. The inherent simplicity of the design, particularly the requirement that each packet must be acknowledged, reduces the number of states and actions and the amount of state information that must be maintained to a minimum. Figure 1 shows a simplified version of a state diagram for Kermit receiving a file.

The receiver initially starts out in the Receive Init state and waits for the other side to send a Send Init packet. If any other packet is received or the Send Init does not arrive within the time-out interval, a NAK (negative acknowledge) is sent. Time-outs or NAKs can occur up to a threshold that, when exceeded for a particular packet, causes the protocol to assume that the connection has become unusable and to give up. After the Send Init arrives, the state becomes Receive File; Kermit waits for a File

(continued)

Header packet containing the name of the file that is to come. When the File Header arrives, Kermit opens a new file using the name provided (perhaps transformed to suit local naming conventions or to avoid a name collision) and switches to the Receive Data state.

Kermit then receives the contents of the file, until an EOF (end of file) packet arrives. At that point, Kermit switches back to the Receive File state. If another file is to be sent, another File Header packet will follow, otherwise an EOT (end of transmission) packet will terminate the transfer. The distinction between EOF and EOT, plus the File Header itself, allows files to be sent in groups. EOF marks the end of a file; EOT marks the end of a group. This distinction also allows the two sides to disconnect cleanly: the EOF must be acknowledged before the sender will believe the file has been transmitted correctly; the EOT will follow, but if the ACK (acknowledge) sent in response to the EOT is lost, no harm will be done since both sides are terminating anyway.

For simplicity, some transitions are not shown in figure 1:

- If in any state a bad packet is received or a time-out occurs, a null transition back to the same state occurs, with a NAK for the expected packet.
- In any state an error may occur that can cause the transfer to terminate. For instance, the target disk might fill up. The side that encountered the error sends an error packet containing an informative error message and quits. Upon receipt of the error packet, the other side displays the message on the screen (if it is in control of the screen) and also quits.
- Actions that are taken on each transition, such as opening a file when a File Header packet is received, are not shown; in particular, each packet successfully received is acknowledged with an ACK.

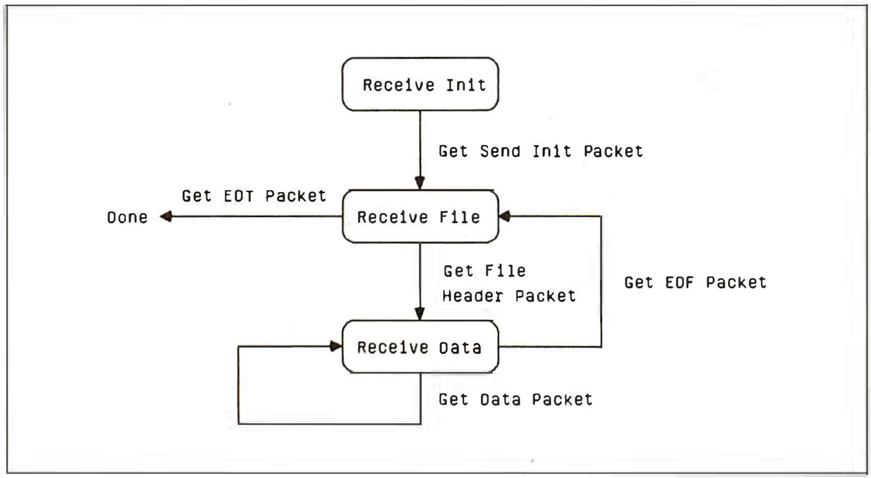


Figure 1: A *simple state diagram for Kermit receiving files.*

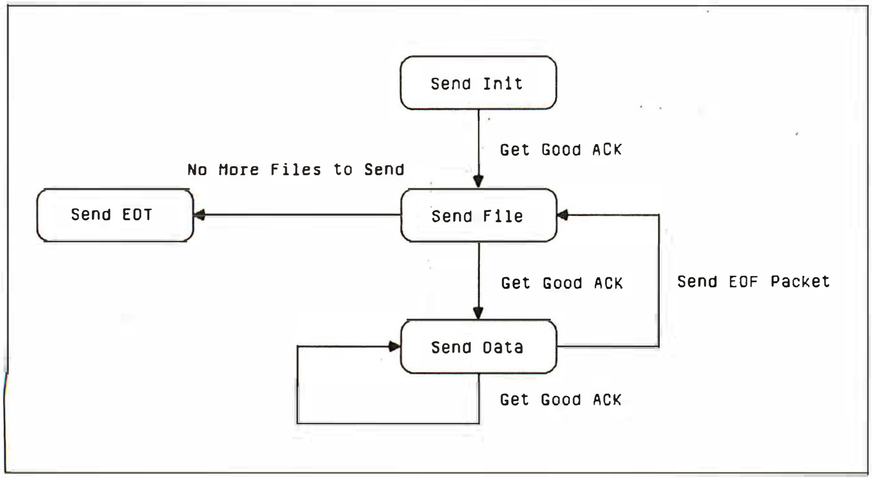


Figure 2: A *simple state diagram for Kermit sending files.*

1	2	3	4	5	6	7	8	9	10	11
MAXL	TIME	NPAD	PADC	EOL	QCTL	QBIN	CHKT	REPT	Reserved	

Figure 3: *The setup parameters in the* DATA *field of the Send Init packet of the Kermit protocol.*

The state transitions for a sending Kermit are similar (see figure 2). In each state, instead of waiting for particular packet types, Kermit sends the appropriate packet and waits for an ACK. If the ACK does not arrive within the allotted time, or a NAK appears instead of an ACK, the same packet is retransmitted. A send operation begins with a Send Init packet, includes one or more files starting with a File Header, followed by one or more data packets and then an EOF. When all the specified files have been sent, an EOT packet closes the connection and terminates the operation.

Base-level Kermit provides that during any particular transaction the sender is the master and the receiver is the slave. These roles may be reversed in the next transaction; any Kermit implementation is capable of acting as either the master or slave. In addition, mainframe implementations may also be put in a kind of permanent slave, or server, mode in which all commands come in command packets from the master, or user, Kermit.

Initial Connection

To allow a diverse group of computers to communicate with one another, an exchange takes place during the initial connection in which the two sides configure each other. The sending Kermit includes setup parameters in its Send Init packet, and the receiving Kermit responds with an ACK packet containing the corresponding parameters as they apply to itself. The DATA field of the Send Init packet is shown in figure 3. The fields are as follows ("I" and "you" are used to distinguish the two sides). Fields are encoded printably using the char function (ASCII [American National Standard Code for Information Interchange] value 32) unless indicated otherwise:

MAXL—The maximum-length packet I want to receive, a number up to 94. You respond with the maximum you

want me to send. This allows systems to adjust to each other's buffer sizes or to the condition of the transmission medium.

TIME—The number of seconds after which I want you to time me out while waiting for a packet from me. You respond with the amount of time I should wait for packets from you. This allows the two sides to accommodate different line speeds or other factors that could cause timing problems.

NPAD—The number of padding characters I want to precede each incoming packet; you respond in kind. Padding may be necessary for a half-duplex system that requires some time to change the direction of transmission.

PADC—The control character I need for padding, if any, modified by XOR with 64 to make it printable. You respond in kind. Normally the null character (NUL), some systems use the delete character (DEL). This field is ignored if the value NPAD is zero.

EOL—The character I need to terminate an incoming packet, if any. You respond in kind. Most systems that require a line terminator for terminal input accept a carriage return for this purpose. (Can you see the catch-22 here?)

QCTL—The printable ASCII character I will use to quote control characters or prefix characters, normally #. You respond with the one you will use.

QBIN—The printable ASCII character I want to use to quote (prefix) characters that have the eighth bit set, for transmitting binary files when one or both systems cannot use the parity bit for data. Since this kind of quoting increases both processor and transmission overhead, it is normally to be avoided.

CHKT—Check type, the method for detecting errors. 1 for single-character checksum (the normal method), 2 for two-character checksum, 3 for three-character CRC-CCITT. If your response agrees, the designated method will be used; otherwise, the single-character checksum will be used. Other check types may also be added.

REPT—The prefix character I will use to indicate a repeated character. This can be any printable character other than blank (which denotes no repeat count prefix), but ~ is recommended. If you don't respond identically, repeat counts will not be done. Groups of four or more identical characters may be transmitted more efficiently using a repeat count, although an individual implementation may wish to set a higher threshold.

CAPAS—An extendable bit mask encoded printably, to indicate whether certain advanced capabilities, such as file-attribute packets, are supported.

Reserved Fields—The next four fields are reserved for future use. Those wishing to add their own parameters to the initial connection exchange should start at the fifth field after the capability mask in order to remain compatible with other Kermit programs.

Naturally, the three prefix characters must be distinct and should be chosen to be uncommonly used printable characters to minimize further overhead from having to prefix them when they are found in the data.

The trailing fields in the DATA field may be omitted, in which case they will assume appropriate defaults. Defaults for intermediate fields can be selected by setting those fields to blanks. Every parameter has an appropriate default. In fact, the entire DATA field of the Send Init packet or its ACK may be left empty to accept all defaults. The more exotic parameters are at the end and reflect more recent developments in the Kermit protocol; earlier implementations can still communicate with newer ones, since there will not be agreement to use these options. The Send Init mechanism preserves compatibility from the earliest Kermit to the most recent.

There is no protracted negotiation; everything must be settled in a single exchange. Some parameters, however, are outside the scope of this exchange and must be set even before the first packet is sent. For instance, if the receiving computer can read only characters with odd parity, but the sending computer sends them with even parity, the Send Init packet will never arrive successfully. In cases like this, the user may have to issue some preliminary commands to inform one or both Kermit programs about the vagaries of the other system. Another example is the packet terminator (EOL) mentioned above—if the receiving Kermit requires one that the sending Kermit doesn't know about, the Send Init will never get through.

For these reasons, most implementations of Kermit provide SET commands for all the parameters listed above and some others as well.

During initial connection, an exchange takes place between the computers using Kermit in which the two sides configure each other.

RULES AND HEURISTICS

During a file transfer, one Kermit sends information packets—file headers, data, and so forth—and the other Kermit sends only ACKs or NAKs in response. The most important rule in the Kermit protocol is *wait for a response before sending the next packet*. This prevents buffer overruns and allows participation by half-duplex systems. Of course, Kermit should not wait forever; a time-out should occur after a few seconds if the expected packet has not arrived. Upon time-out, a sending Kermit retransmits the current packet; a receiving Kermit reacknowledges the current packet or negatively acknowledges the expected one.

Some interesting heuristics are used in Kermit to boost efficiency and improve error recovery. A number of important rules take care of the cases when packets are lost in transmission. The first can be stated as *a* NAK *for the next packet implies an* ACK *for the current packet*. A NAK with packet number $n+1$ means the receiving Kermit got packet n, sent an ACK that was never received, and, not knowing that the ACK didn't get through (since we don't acknowledge an ACK), is now waiting for packet $n+1$, which was never sent. In this case, we simply send packet $n+1$. An important exception is when the missing ACK is for a Send Init packet; do you see why? The next rule, *acknowledge and discard redundant packets*, handles the situation where the same packet arrives again. The sending Kermit timed out waiting for an ACK that was sent but lost and retransmitted the packet. The receiver must discard the redundant data and acknowledge the packet again; to do otherwise could have undesirable effects, such as adding the same data to a file twice or opening the same file multiple times. Note that the situation resulting from a lost ACK depends upon which side times out first.

Kermit must handle another situation arising from possible lost packets: *nega-*

(continued on page 400)

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Pascal/MT+	√	√	√	√	√
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C		√	√	√	√
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Video

COMPUTERS AND VIDEO appear to offer an endless variety of combinations, as this month's cover by Robert Tinney depicts. With an increase in higher-power communication satellites that require smaller, less-expensive user antennas and electronics, and with the melding of television receivers and microprocessors, we might look ahead to the day when worldwide person-to-person visual as well as aural communication is based on personal computers and not on a direct descendant of Mr. Bell's original invention. "Bulletin Boards in Space," described by John Markoff in the May BYTE West Coast column (page 88), may give way to worldwide electronic conferencing and conventioning by adding television cameras to the growing list of common personal computer user options.

Many videotex, work-alike, and other interactive cable-television-based systems already exist. With the proliferation of coaxial-cable interconnection and its high-speed data-transmission capabilities, more and more homes and businesses could be linked via computer-controlled video instead of the restricted-bandwidth, audio-frequency-based systems now in use.

Shopping via computer is already a reality in some areas. With television- or presentation-level graphics, perhaps complicated and expensive encoding schemes could become unnecessary because you might be able to view the person to whom your message is directed. And as Rich Malloy, our product-review editor, stated in the July 1983 BYTE in his introduction to the Videotex theme, the printing presses might stop and BYTE could be delivered to you electronically.

Though with us for over a generation, until recently hardware costs made computer and video interactivity limited and expensive. In recent years, dramatic advances in digital electronics and large-scale integration (LSI) have made personal computers, videocassette recorders (VCRs), and videodiscs available to anyone with a down-to-earth application or interest in learning. In this issue, we present articles on a wide range of topics related to computers and video.

Peter R. Cook's article, "Electronic Encyclopedias," explores something that all of the major encyclopedia publishers have talked about for several years: how to develop an "intelligent encyclopedia" that uses natural means of accessing and using knowledge. Included with this article is contributing editor Mark Dahmke's look at "An Ideal Video Peripheral," a glimpse at how personal computers and videodiscs might communicate more efficiently.

In "Televisions as Monitors," Ken Coach describes some of the characteristics common to the new generation of television receivers that can double as microcomputer video monitors.

If you already have an inexpensive VCR with limited or no programming capabilities or are considering purchasing one, Cy Tymony's "Computer Control of a Video Recorder" should be particulary interesting. This construction project enables you to use your micro as a programmable control center for your VCR.

Stan Jarvis's "Videodiscs and Computers" takes a look at the videodisc industry, its evolution, and the myriad of companies and equipment facing personal computer owners.

As an example of what you can do with a CAV (frame-addressable) videodisc, Rod Daynes and Steve Holder designed a game around a generic version in "Controlling Videodiscs with Micros." They used the videodisc support commands available in the Sony SMC-70 computer.

—*Gene Smarte, Managing Editor*

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ELECTRONIC ENCYCLOPEDIAS

BY PETER R. COOK

Interactive video technologies help explore "the realm of worthwhile knowledge"

ENCYCLOPEDIAS EVOKE special memories for most people. When you were a child, you probably did research for essays and class projects, looked for "naughty" words and pictures, struggled through dull facts about dead people, or discovered fascinating facts in articles from "Aardvark" to "Zygote." Later on, maybe you used an encyclopedia to solve crossword puzzles, to help a child with homework, or to look up the location of a vacation spot or an unfamiliar country mentioned in the news.

Now there is a whole new range of associations that most people wouldn't normally connect with an encyclopedia: on-line databases, videotex systems, and laser videodiscs—new interactive technologies that, at first glance, might appear to be the very antithesis of the traditional printed encyclopedia. But major electronic publishing companies are beginning to create a new generation of encyclopedias, powerful informational/educational tools that can interact through, and with, all of these new media.

As part of a long-range development plan, Grolier is creating a massive encyclopedic database of text and audiovisual materials that can be accessed and manipulated using interactive technologies. The two major components of this plan, the text database and the audiovisual database, currently are being developed along separate but convergent tracks—one utilizes on-line or videotex technology, the other utilizes videodisc technology.

In this article, I will review both development tracks, observing from the publisher's point of view how information is enhanced by delivery via new interactive technologies. But let's begin with a look at encyclopedias delivered via a traditional interactive medium—the book. Though new technologies should not slavishly imitate those that preceded them, there is much to be gained by using the book metaphor for building the foundation of an information tool that utilizes the full power of interactive video technologies.

According to an entry in the *Academic American Encyclopedia* (AAE), a printed general encyclopedia "attempts to present the entire realm of worthwhile knowledge: the humanities and literature; fine, applied, and performing arts; science and technology; history and social sciences; critical issues such as bioethics and civil rights; and select data on significant places and persons."

Mechanics and economics tend to limit the size of a printed encyclopedia's "realm of worthwhile knowledge"; of necessity, the information itself is synthesized and summarized. Distillation and outlining of knowledge, along with broad coverage, make a general encyclopedia—whether it be in 1, 20, or 30 volumes—a useful reference tool.

The reference characteristics of encyclopedias are what brought about their rather unnatural, usually alphabetical, information structure. There is no inherent logic in grouping "Aardvark" with "Alvar Aalto" and "Hank Aaron," although such curious juxtapositions often create wonderfully serendipitous discoveries. Diverse subjects are thrown together for no reason other than the fact that an alphabetical, dictionary-like organization improves access to information. Some encyclopedias still cling to the earlier thematic approach in which related information is grouped together. Thematic groupings make it possible for information to be viewed in a broader context, but highly specific facts are harder to locate.

Alphabetical encyclopedias compensate for the seemingly arbitrary arrangement of their articles by using in-

(continued)

Peter R. Cook is vice president of creative services for Grolier Electronic Publishing Inc. (95 Madison Ave., New York, NY 10016). He is responsible for coordinating the development of that firm's Multi-Component Electronic Encyclopedia, *which is intended to combine videodisc and videotex technology. Cook spent five years at Arete Publishing Co., producing the* Academic American Encyclopedia.

tegrated cross-references that indicate the presence of related articles and draw connections between the various realms of knowledge. In its current (fifteenth) edition, the *Encyclopædia Britannica* attempts to overcome the shortcomings of this alphabetic tyranny by breaking the set into three resources: *Propædia*, a one-volume overview of knowledge; *Macropædia*, a collection of in-depth articles (many of considerable length) on broad areas of knowledge; and *Micropædia*, containing very short articles as well as discrete, specific facts. The attempt, however, is thwarted by the awkwardness of three integrated, but *separate*, resources.

While encyclopedias may have to struggle with the drawbacks of their own unique organizations, they also exhibit the positive characteristics of the printed book. Books are physical entities, portable random-access devices. Their organization is universally recognized: pages, chapters, tables of contents, prefaces, introductions, indexes, bibliographies, etc. They are the framework of written language. Other characteristics inherent in books let you browse through them easily and give you a sense of scale and place. You know how to navigate in a book.

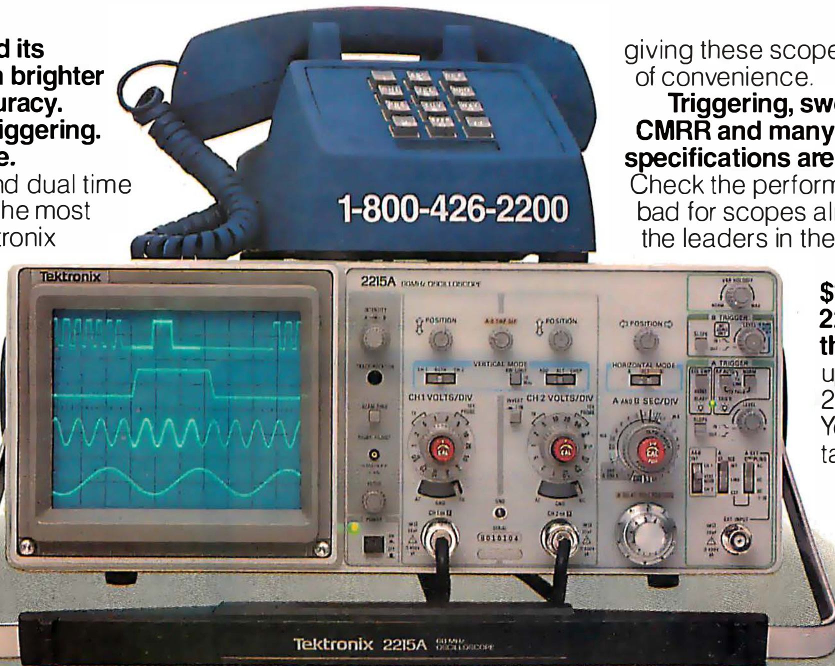
But the book also has its limitations. It is a fixed medium: once printed, it cannot be changed. The only way for a user to update a printed encyclopedia is to buy a new one, write notes in the margin, or purchase the yearbook that most encyclopedia publishers issue annually to maintain the currency of existing sets. The information is also fixed in that it cannot be dynamically rearranged for the user's convenience. Comparing all the articles on dinosaurs, for example, might require accessing more than a dozen volumes. Information access is also limited by the specificity of the article titles and by the quality of the index—nonindexed information is almost the equivalent of *no* information. Finally, no matter how descriptive the text or how informative the illustrations, no printed encyclopedia can capture the power of a place, person, or event more vividly than an audiovisual medium. Yet the printed encyclopedia is, and will continue to be, a highly valued information resource for most people.

(continued)

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Input capacitance	20 pF	30 pF
CMRR	10 to 1 at 25 MHz	10 to 1 at 10 MHz
Channel isolation	100:1 at 25 MHz	Not specified
A Trigger sensitivity (int)	0.3 div at 5 MHz	0.4 div at 2 MHz
TV triggering	1.0 div compos. sync	2.0 div compos. sync
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Holdoff Range	10:1	4:1

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Now consider an electronic encyclopedia that uses the full power of new interactive media and is designed to meet the needs of a new generation of users.

ELECTRONIC REFERENCE WORK

In 1982, Grolier acquired the rights to the *Academic American Encyclopedia*, a new 20-volume general-reference work designed for use in homes and schools. Containing approximately 30,000 articles and 9 million words, the AAE is characterized by its currency and its short entry format (its articles have an average length of approximately 300 words). For us it had the additional virtue of being typeset entirely with computerized equipment, and thus it could be converted for on-line dissemination.

The electronic edition of the AAE has been in existence for two years and is currently available to over 250,000 online and videotex subscribers through existing information utilities. These include services such as CompuServe, Dow Jones News/Retrieval, BRS, Dialog, and Vu/Text. We also distribute through NAPLPS (North American Presentation-Level-Protocol Syntax, or "naplips") graphics-based systems: Viewtron, Keycom, and Times Mirror's Gateway (which uses Telidon graphics, a forerunner of NAPLPS). Users accessing the encyclopedia remain customers of the information utility, which in turn pays Grolier a royalty.

The encyclopedia's inherent data structure has to be adapted to the display characteristics and access protocols of individual systems. Because these system requirements have a considerable effect on how the user interacts with the encyclopedia, it is worth reviewing some samples at length, beginning with the less complex, and consequently less powerful, systems.

VIEWTRON: AN ASCII/NAPLPS HYBRID

Viewtron, operated by Viewdata Corp. of America (a Knight-Ridder subsidiary), is the first commercial videotex service to use NAPLPS color graphics, which can be accessed only by AT&T's Sceptre terminal. This regional service is now available in just three Florida counties; if successful, however, the service will become available in major cities around the country.

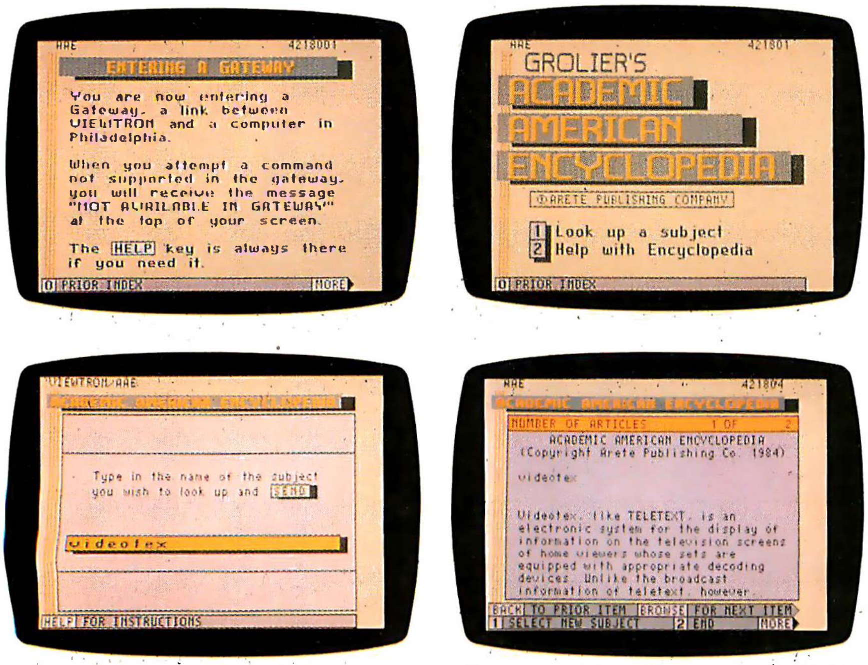


Photo 1: *A Viewtron subscriber selects the* Academic American Encyclopedia (AAE) *from one of the many submenus that list the several hundred topic areas available through the service and is then linked via a communications "gateway" (1a) to the* AAE *database (1b), housed on the computer of* Vu/Text *in Philadelphia. The user types in a search term—in this case "videotex"—(1c) and the system searches for an encyclopedia article with that title. In photo 1d, the system displays the first screen of information. While the user is accessing information from the* AAE, *the screen display is in a dual mode: a static* NAPLPS *color border surrounding an active "window" for the encyclopedia's* ASCII *text.*

Viewtron is a relatively simple menu-driven system that stores most of its databases on preexisting frames. However, because the AAE is a large database (by videotex standards), it is actually accessed through a communications gateway. The AAE text is housed on computers at Vu/Text (another Knight-Ridder subsidiary) in Philadelphia; the computers are linked by dedicated line to the Viewtron host in Miami. A user accessing the system is connected via the gateway as soon as he selects the AAE from a menu (see photos 1a through 1d). The videotex terminal "paints" the appropriate NAPLPS frame, but it has an active window for displaying the ASCII (American National Standard Code for Information Interchange) text from the Vu/Text gateway. The user is then prompted to type in a search term, which is matched against the AAE's 30,000 article titles. If an exact match exists, the system displays the first 15 lines of the article and the user can "page" through the rest at his own pace. If the search term is too broad, a number of articles are selected. For example, if just "Lincoln" is entered for information on Abraham Lincoln, the system locates all articles with the word "Lincoln" in the title, including "Lincoln, Nebraska" and "Lincoln Center for the Performing Arts." The first article is displayed with the qualifier "1 of *n* [articles]," and the subscriber can then use the system's "browse" function to scan the first frame of each article.

ASCII (NON-GRAPHIC) VIDEOTEX SERVICES

Dow Jones News/Retrieval and CompuServe are both consumer-oriented information utilities that primarily use keyword and menu-driven access. A subscriber logging onto Dow Jones News/Retrieval is guided to the AAE via names and enters a search term or query that is matched against article headings. If the search term is in more than one heading, the system generates a menu, listing all of the articles, and the user selects from this (see figures 1a

(continued)

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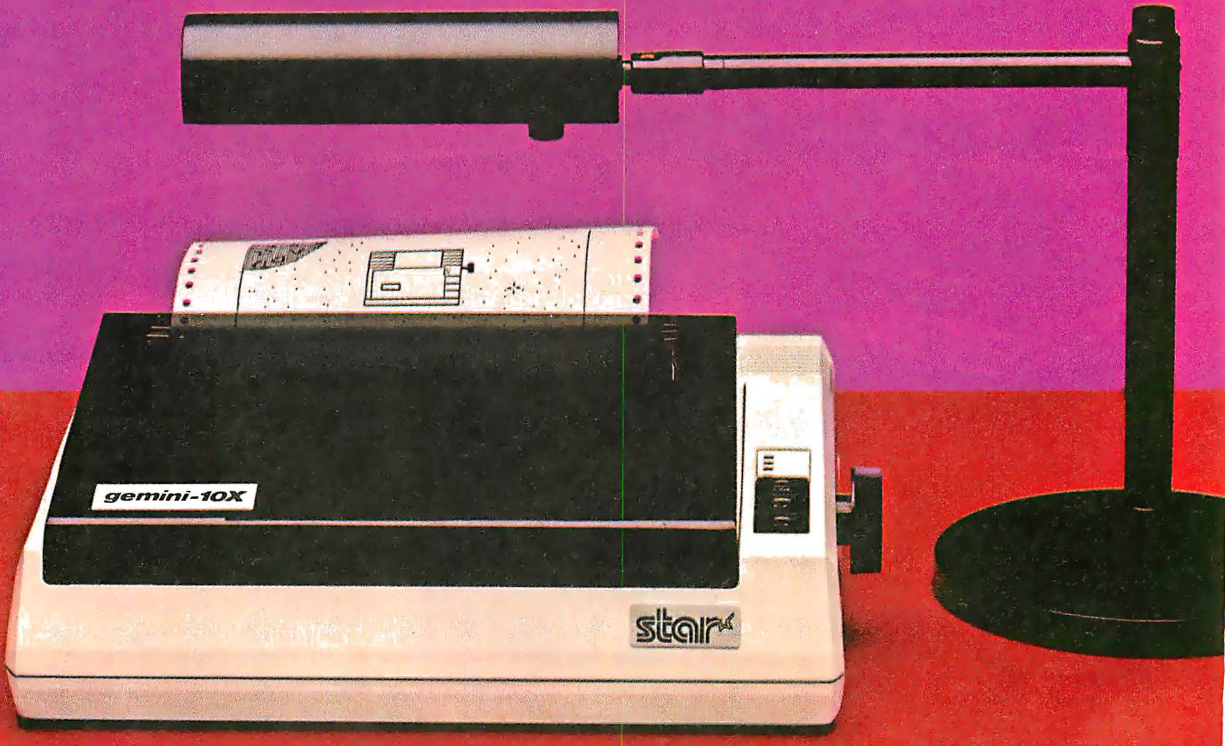
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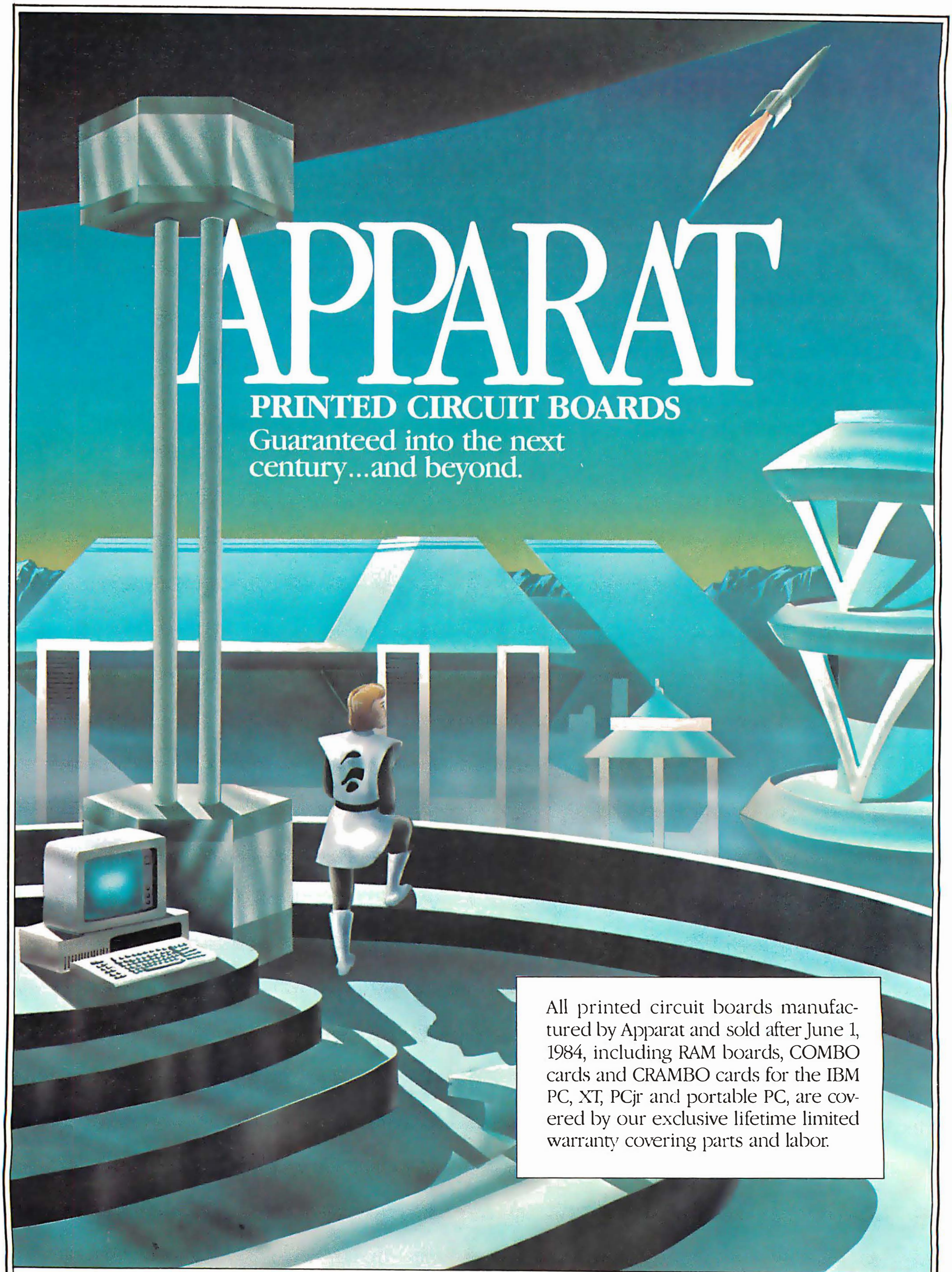
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(1a)

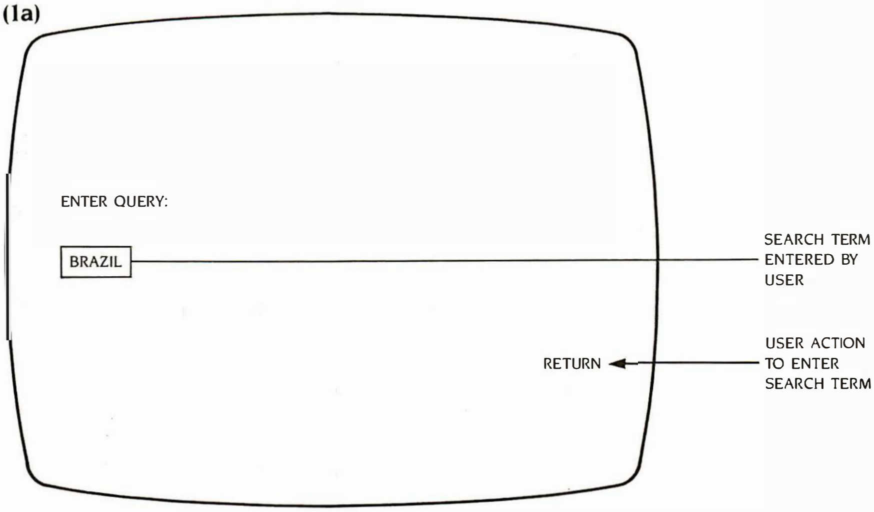


Figure 1a: *A subscriber to Dow Jones News/Retrieval can access information in the encyclopedia by typing in his search term or query. In this case, the search term is "Brazil."*

through 1e). If the selected article is long, an additional menu (or series of menus) is shown, providing a numbered outline of the contents. Thus, the user can select the most appropriate section without having to page through the entire article.

Dow Jones News/Retrieval also lists the number of pages or screens of text in each article and lets the viewer know which page he is viewing (2 of 14, etc.). CompuServe gives each page an individual number, which can be used in conjunction with the GO command to go directly to the page, bypassing the intermediate menu stages. As useful as these features are, menu-driven systems are limited. Access is through the article title only, which doesn't open up the full potential of an electronic encyclopedia.

Free Text Databases

Two much more powerful on-line database systems are BRS and Dialog. Considerably more expensive than the consumer databases, BRS and Dialog use free text search procedures in which *every word* in the database is indexed and therefore can be searched.

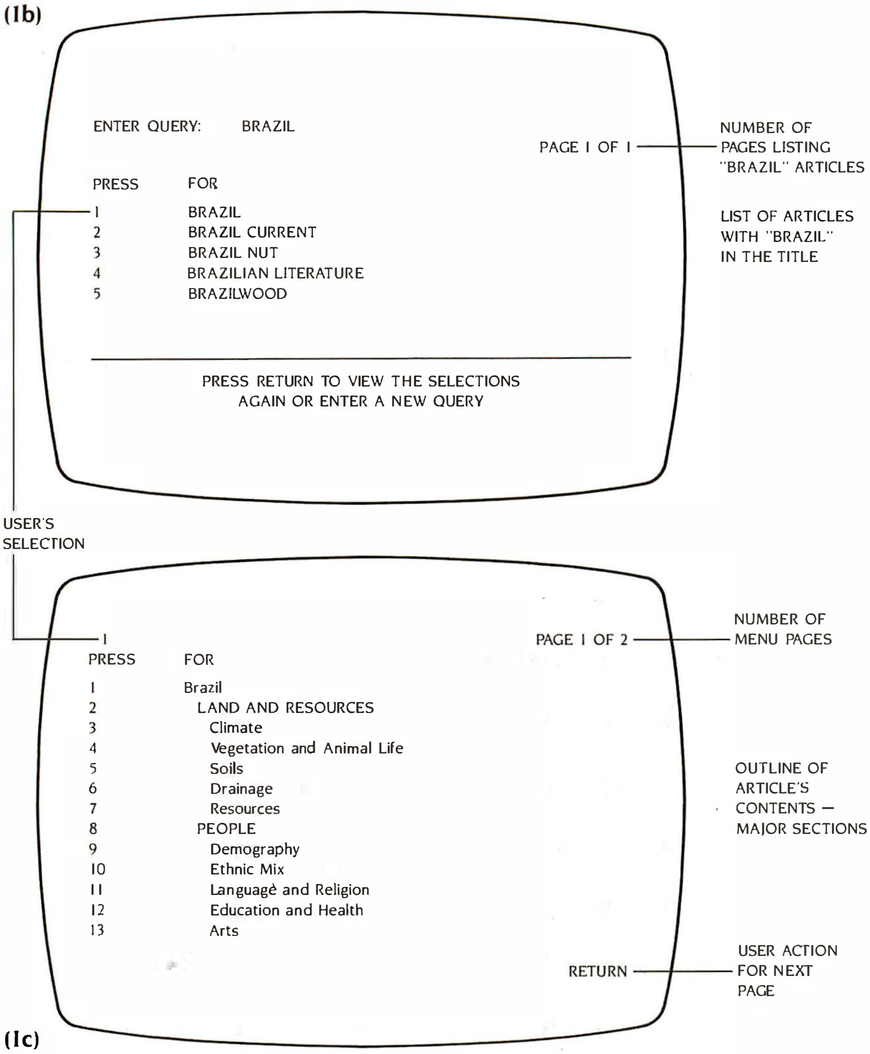
When accessing via BRS, a search term or query is entered using the required command language. However, if the search term is not properly qualified, the system may locate far too many occurrences to be helpful. For example, a search for "Einstein" produced several hundred "hits" (occurrences) of the word in 69 articles throughout the encyclopedia (see figures 2a through 2c). But the search can be narrowed down by using Boolean operators such as *and*, which combines two search terms in the same article; *same*, which combines two terms in the same paragraph; *with*, which combines them in the same sentence; and *adj*, which requires the two terms be directly adjacent. If what I really want to find out about Einstein is when he moved to Princeton, I would phrase the search as: "Einstein same Princeton," which means I'm looking for the paragraphs in which both of the words appear. This narrows the hits down to just two paragraphs, which can be quickly displayed. These paragraphs tell me that Einstein moved to Princeton in 1933 and that he died there in 1955.

This simple example doesn't really illustrate the full retrieval capabilities of free text systems. They can be powerful tools in the hands of an experienced researcher or librarian. On the other hand, their complex command syntax and Boolean search logic make them too complex for easy access by most untrained users.

In an effort to broaden the appeal and usage of their services, BRS and Dialog have both introduced easier-to-use and less expensive off-peak services: BRS After Dark and Knowledge Index, respectively. Communications software is

(continued)

(1b)



(1c)

Figures 1b and 1c: *In the top screen, the system generated a menu listing all the articles with "Brazil" in the title. The bottom screen shows that the article on the country of Brazil (selection #1 on the top screen) was selected and the first page of an outline of the article's major sections is displayed.*

also being introduced; Sci-Mate and In-Search simplify command procedures and enable the user to develop a search strategy before going on line. Such efforts are the first steps in what will undoubtedly be a series of software products aimed at making these information utilities (including Dow Jones News/Retrieval and CompuServe) more powerful and easier to use.

Earlier I used the printed book as an example of a medium with which we are manifestly familiar; the reason for our familiarity is that the structure and conventions of books have been evolving for centuries. On-line databases have been in use for little more than a decade, and it is only in the last two or three years that large numbers of untrained users have started accessing them. Consequently, the learning curve for everyone—system operators, information providers, and end users—is particularly steep. There is still much to be learned about how users interact with electronic information utilities, what kinds of displays are best, what accessing protocols and commands are most effective and easy to learn, and what information is most appropriate.

Enlarging the Database

The electronic edition of the AAE is already quite different from its printed parent. Updated twice a year instead of annually, it has no physical growth limitations, unlike the printed work. We intend to use this essentially unlimited capacity for growth: to respond directly to users' needs; to reflect areas of strong current interest; to broaden the

(continued)

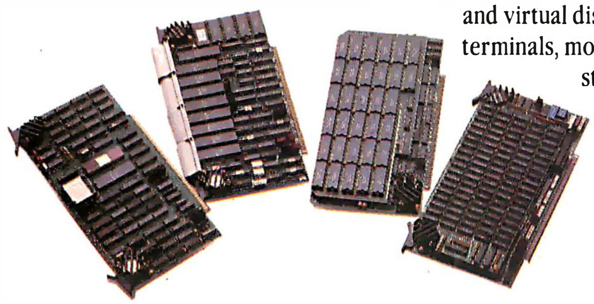
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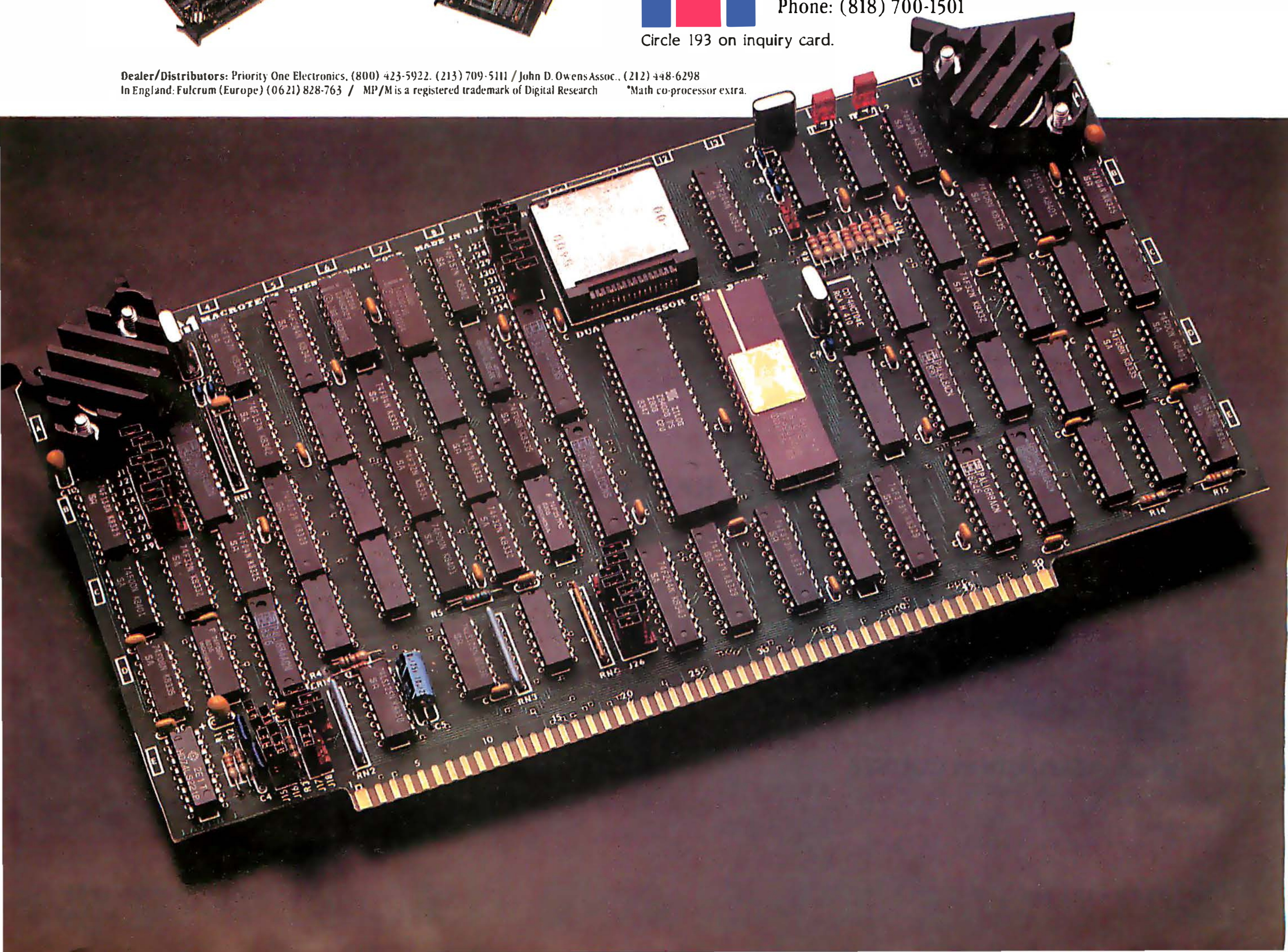
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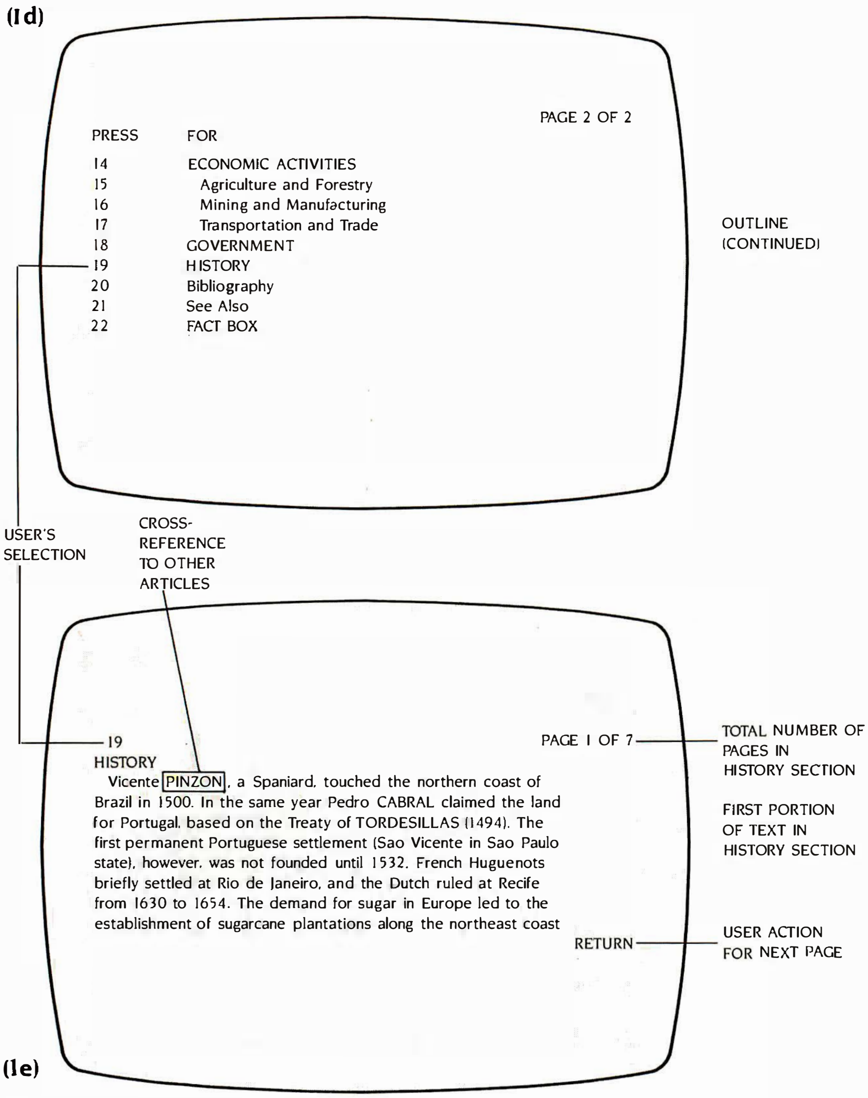


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Figures 1d and 1e: *In the top screen, the outline started in figure 1c is continued. In the bottom screen, the user has chosen #19, the history section, and the first "page" is displayed.*

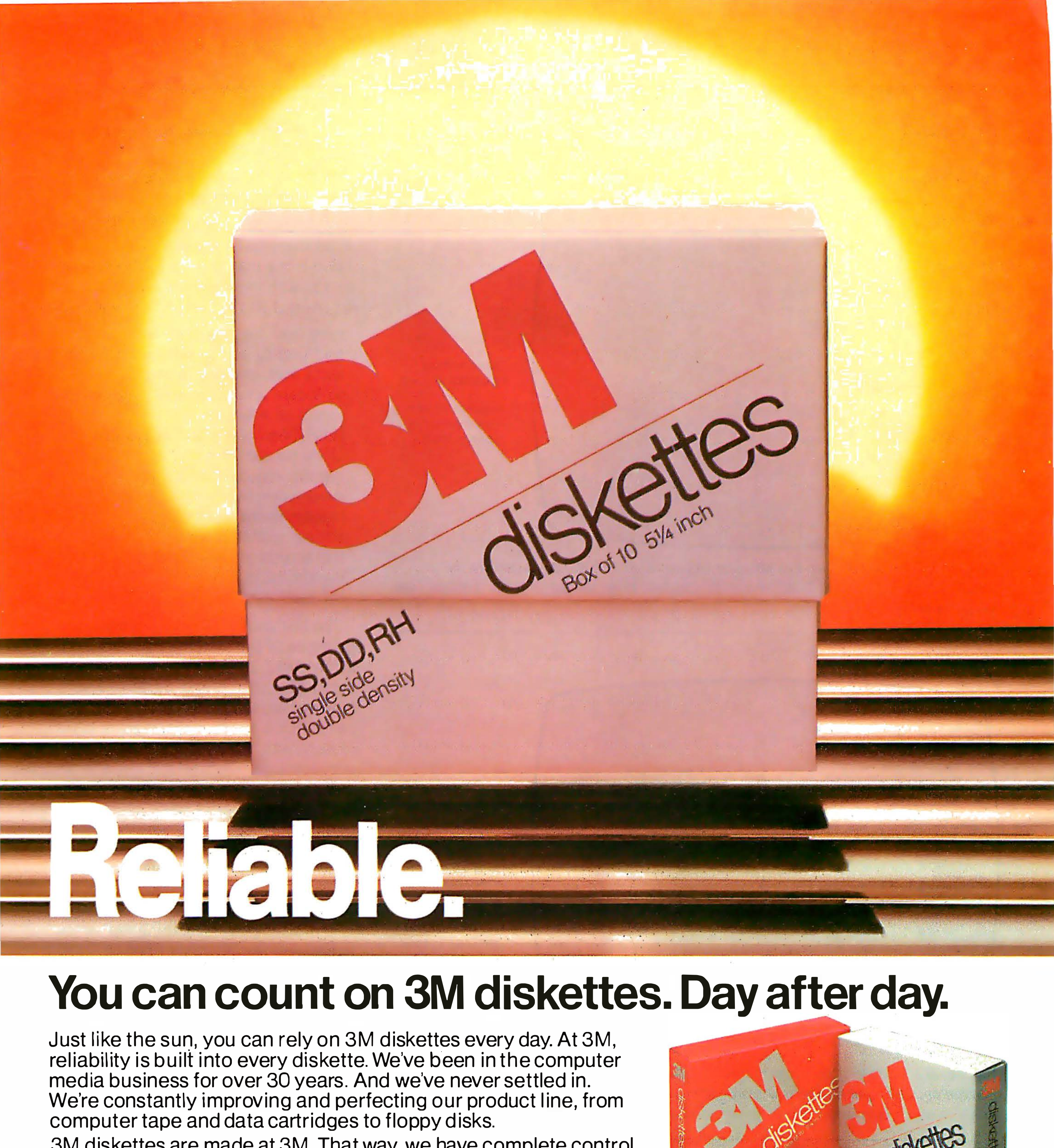
database so it is more appropriate to different age and interest levels; and to develop satellite databases designed to interact with the encyclopedia.

Responding to users' needs: An electronic encyclopedia has a unique advantage over its print counterpart because it is possible to "capture" such key parts of the information transaction as search terms and usage time. Analyzing the captured data can reveal shortcomings, whether in the form of inadequate article headings or missing information. Such data also reveals areas of high and low interest—a useful guide for database growth.

Reflecting areas of strong current interest: Printed encyclopedias contain little information of transitory interest. It will be a long time before the *Britannica* has an article on Michael Jackson. This isn't necessarily because encyclopedia editors disdain popular culture. The physical limitations of the printed work make it difficult and costly to inse t large numbers of new articles each year. Space has to be found for each new article, usually at the expense of other articles. Further, an article of fleeting interest may create a difficult hole to fill when its importance diminishes.

This is not the case with an electronic edition, in which articles can be added to and deleted from the database with considerable ease. For example, coverage of the Olympic Games and athletes can grow in anticipation of this year's meeting in Los Angeles. Next year the coverage can be reduced. An electronic encyclopedia can be a truly responsive, dynamic reference work.

(continued)



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(2a)

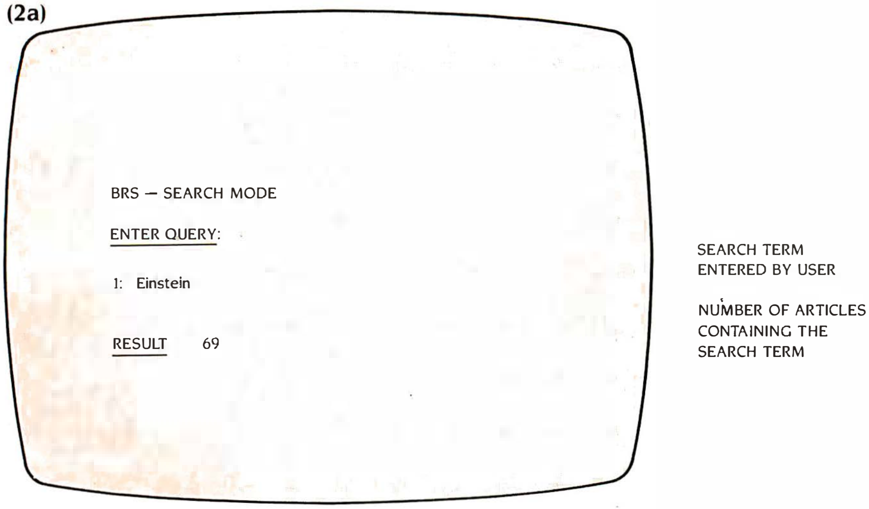


Figure 2a: *On powerful on-line database systems such as BRS, every word in the encyclopedia is indexed and therefore can be searched. Here, the search term "Einstein" was located in 69 articles.*

(2b)

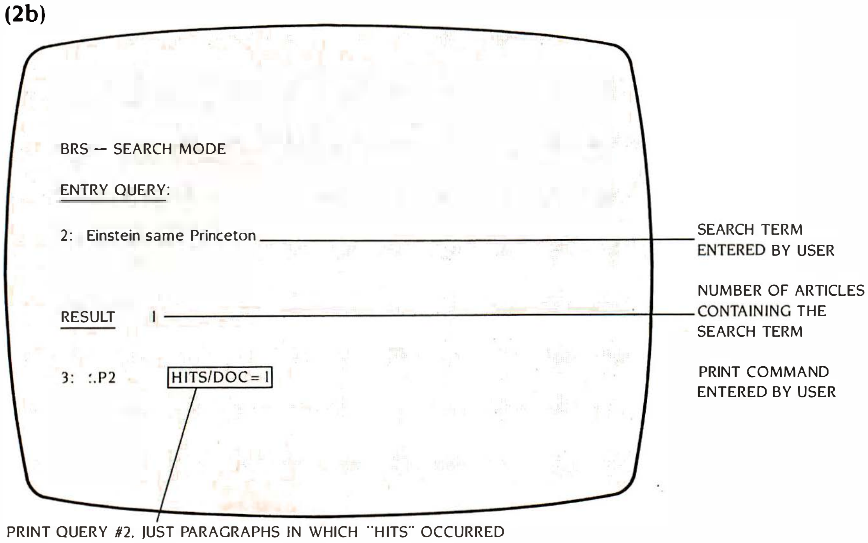


Figure 2b: *Because of the large number of articles, the search was narrowed by using the Boolean operator "same." The new search term, "Einstein same Princeton," located only one article in which both words appear in the same paragraph.*

Expanding for a broader audience: In its present form, the AAE spans a wide range of age and interest levels. As stated in its preface, the AAE is "for students from junior high school, high school, or college and for the inquisitive adult." By expanding that base to include young children and advanced scholars, the resulting database will be several times larger than the printed encyclopedia and will be capable of responding appropriately to the user's age and interests.

Satellite databases: Grolier has recently completed the first of a series of satellite database products designed to interact with, and be enhanced by, the electronic encyclopedia. Whiz-Quiz is a menu-driven educational game that directs the player to the AAE to find out more about a topic. We believe that children in particular will be compelled by this mechanism to explore the encyclopedia.

The User Interface

Regardless of what shape or direction a database takes, the key to its use and value is the user interface. The user interacts with the electronic encyclopedia on several distinct levels:

entry level: logging onto a system and getting to the database
search level: entering a search term to locate a specific article (or group of articles)
retrieval level: once the relevant article is located, finding and retrieving the required information
manipulation level: getting the information in the form of a printout, writing words down directly from the screen, or simply remembering the facts
exit level: leaving the database

The first and last levels are entirely the province of the system's operator and, in any event, are not an obstacle to most users. The search and retrieval levels, however, are areas of major concern because that is where the user works most closely with the system. The information-manipulation level will become increasingly important as software is written to take full advantage of encyclopedic databases.

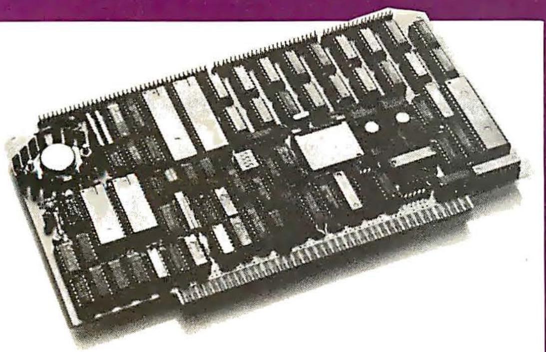
The best way to analyze potential improvements at the search level is to return to the book metaphor. As an access device, a book is very forgiving. When you look something up in an index, you usually don't need to know the exact spelling to locate it. Likewise, you sometimes use a dictionary because you *can't* spell a word but have no problem locating it.

Databases are not so forgiving. A misspelled search term, no matter how close to the correct word, cannot be used to locate the required article. Some systems attempt to overcome this by providing a function called *truncation*. On Dow Jones News/Retrieval, for example, all you have to enter for an article on Zbigniew Brzezinski is "BRZ"—a nice feature, but not the complete solution. The problem isn't just misspelling; children in particular tend to use plurals for certain common nouns: cats, dogs, trees, dinosaurs, etc. This is not a problem in a printed reference work; however, when entered on a videotex system, the search terms will fail to match

(continued)

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Circle 189 on inquiry card.

(2c)

```
TI   Einstein, Albert ———————————————— ARTICLE TITLE
TX
     1 of 14. The German-American physicist Albert Einstein, b. Ulm, Germany, Mar.
     14, 1879, d. Princeton, N.J., Apr. 18, 1955, contributed more than any other
     scientist to the 20th-century vision of physical reality. In the wake of World War
     I, Einstein's theories—especially his theory of relativity—seemed to many
     people to point to a pure quality of human thought, one far removed from the
     war and its aftermath. Seldom has a scientist received such public attention for
     having cultivated the fruit of pure learning.
     4 of 14. By 1909, Einstein was recognized throughout German-speaking Europe
     as a leading scientific thinker. In quick succession he held professorships at the
     German University of Prague and at the Zurich Polytechnic. In 1914 he
     advanced to the most prestigious and best-paying post that a theoretical
     physicist could hold in central Europe: professor at the Kaiser Wilhelm
     Gesellschaft in Berlin. Although Einstein held a cross-appointment at the
     University of Berlin, from this time on he never again taught regular university
     courses. Einstein remained on the staff at Berlin until 1933, from which time
     until his death (1955) he held an analogous research position at the Institute
     for Advanced Study in Princeton, N.J.

     END OF DOCUMENTS IN LIST
```

ARTICLE CONTAINS 14 PARAGRAPHS: ONLY PARAGRAPHS 1 AND 4 CONTAIN "EINSTEIN" AND "PRINCETON"

Figure 2c: *Having located the one article in which both "Einstein" and "Princeton" appear in the same paragraph, a string of print commands displays the text of that paragraph on the screen.*

the exact article titles, which are singular.

First-time users, especially children, make repeated errors when entering search terms. Analysis of the search terms for one of the videotex services reveals that about one-third of all terms failed to locate an article. In approximately 90 percent of those cases, the information existed but errors (misspellings, use of plurals, incorrect positioning of names) prevented the user from finding it, at least on the first try.

Clearly, the unforgiving nature of search-term entry on videotex systems is a frustrating inadequacy that can be improved by the system operators. At the same time, the information provider has a responsibility. Other aids to access are required. Current videotex systems allow only keyword access to article headings. There is no on-line index, and today's videotex systems do not have the full text-indexing capabilities of BRS and Dialog. Clearly, the specific entry headings need to be broadened so that the same information is available via several different search terms. An on-line index would broaden access still further, especially when combined with a thesaurus function.

Free text systems are not restricted to keyword access. Rather, the user can focus his search language to a highly specific degree, examining the body of knowledge with precision. The price of that precision is a high degree of practice and skill.

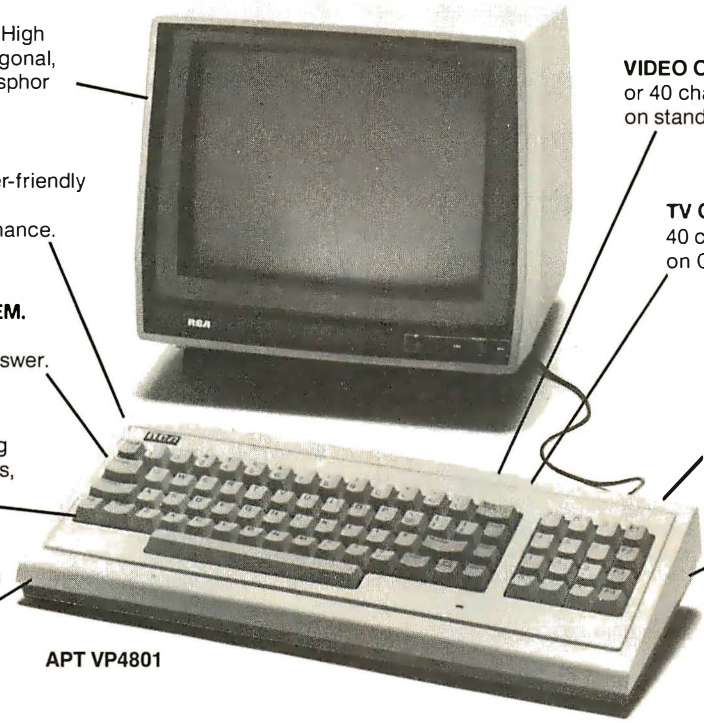
In the long term, both keyword and free text access to large databases probably will give way to search languages with a high degree of artificial intelligence (AI). At present, when you search for information in an encyclopedia, particularly on videotex systems, you have to think about its likely location. You cannot interrogate the database, but this is exactly what you should be able to do, posing such questions as: Who wrote *The Grapes of Wrath*? How many Nobel Prize winners went to Harvard? Where do icebergs come from?

Answers to all these questions can be found eventually with current systems, but a fully developed database incorporating AI search techniques would take you directly to the sources.

Having located an article, the user begins to read it. The "window" into the encyclopedia's massive database is a television or monitor. The text display (depending on the service and the end-user's hardware) varies from 16 lines by 32 characters per line (approximately 85 words) to 25 lines by 80 characters per

(continued)

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An Ideal Video Peripheral

BY MARK DAHMKE

As a software consultant, my major complaint with most of the popular videodisc players is that they communicate with computers very poorly. Typically, the videodisc player is treated as a printer or a plotter; the user has to deal with commands that may or may not be ASCII (American National Standard Code for Information Interchange) format and may or may not be logical and consistent.

The Discovision (now Pioneer) model 7820 had a command set that looked like a selection of random numbers. The codes to send the numerals 0 through 9 were: 3F, 0F, 8F, 4F, 2F, AF, 6F, 1F, 9F, and 5F, in that order. In addition, the 7820 had an IEEE-488 external interface that wasn't compatible with most microcomputers. In an attempted remedy, Discovision built a serial converter box to change the IEEE-488 protocol to and from RS-232C levels. What they came up with was a protocol converter with a 1-byte buffer that could easily be overrun, erasing the last command before it could get to the player.

Even if the translation and protocol conversion problems are ironed out eventually, a programmer is still faced with a stiff challenge in trying to get the status and frame number back from the player. Some players won't give out this information at all. Ones that do return strangely encoded bytes that take many instructions to untangle. On some players the frame number comes back as a 2-byte integer, on another it comes back as four ASCII digits in hexadecimal, and on still another it shows up as five-decimal ASCII digits. Any software expected to run on more than one model of videodisc player has to account for all of these differences.

Timing seems to be the worst problem with interfaces. Data sent to the player at serial-port speeds just can't control a fast videodisc player in the manner required by modern interactive applications. Some new players offer parallel ports, but many computers (e.g., the IBM Personal Computer) don't support full bidirectional interfaces. IBM claims that its Centronics port is "parallel input and output." However, if you check the circuit diagram, you will see that it isn't. It is wired so that reading the port returns only what was last sent.

Newer videodisc players operate at floppy-disk and, in some cases, hard-disk speeds. Some have worst-case access times of 2 to 3 seconds. Within a year or two, I expect to see write-once, multiple-read videodiscs with interfaces to let them be used as archives. (Some current videodiscs can hold gigabytes of data.) For this to work, however, the interface will have to be smart enough to recover the stored data and fast enough to return it to main memory at magnetic-disk speeds. This technique can work, as shown by the fact that it is already being used in several hard-disk backup systems for videotape recording equipment. In these disk-to-tape systems, the data from the disk is recorded redundantly in the scan lines of a National Television System Committee (NTSC) signal, which is then recorded on videotape. While this prac-

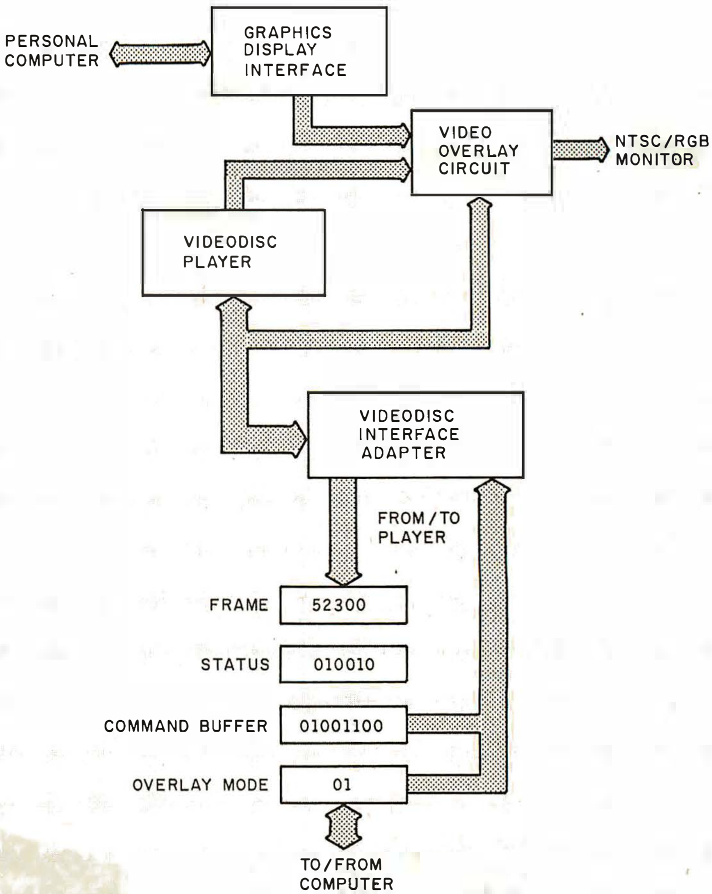


Figure 1: *The hardware configuration for an intelligent videodisc player.*

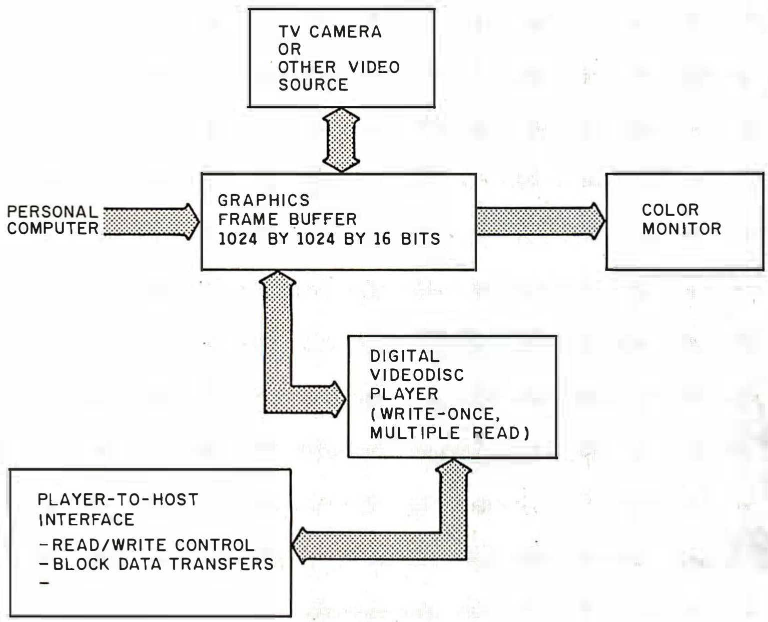


Figure 2: A *second-generation interface built around digital television.*

tice could easily be transferred to videodisc hardware, much of the videodisc would be wasted and not used to its full potential. The developing direct-digital recording techniques will remedy this problem by maximizing use of the disc recording surface.

Loading software into a personal computer from a videodisc as if it were a floppy disk would greatly enhance educational applications. For example, audiovisual and computer-graphics course material (all orchestrated by an authoring language) could be combined and loaded into a personal computer from the first part of a videodisc while just the audiovisual portion is stored separately on the remainder of the videodisc. A development system would consist of the videodisc player and other end-product hardware, but the graphics and curriculum-specific data, or "courseware," would be developed on attached floppy-disk or hard-disk systems.

Figure 1 shows one possible hardware configuration for a first-generation intelligent player. The main feature of the design is the videodisc interface adapter, which would plug into an expansion slot on the microcomputer. The interface adapter gives the programmer tight control over the timing of the player and also controls the video overlay circuit.

As digital television and audio reproduction become affordable and popular (I estimate that this will take five to seven years), we'll be able to define the formats that will let personal computers store and retrieve video images and sound. We'll be able to create high-resolution computer graphics and synthesized music on personal computers and write it onto a write-once videodisc peripheral. We'll then be able to play it back through digital television sets. Alternately, digital television images could be recorded from TV sets onto a videodisc and then retrieved, displayed, or processed on personal computers.

Figure 2 shows a second-generation interface built around digital television. As 32-bit processors become faster, and memory bandwidth greater, it will be possible to directly manipulate high-resolution images that come from the videodisc or are created directly by the microcomputer. The video output from the TV camera can be routed to a digital television for viewing, or the output can be held in the graphics frame buffer for further modification and processing.

Mark Dahmke, a contributing editor for BYTE, *is a software consultant and heads* MCD Consulting Inc. *He can be contacted at* POB 80266, *Lincoln,* NE 68501.

(2a)

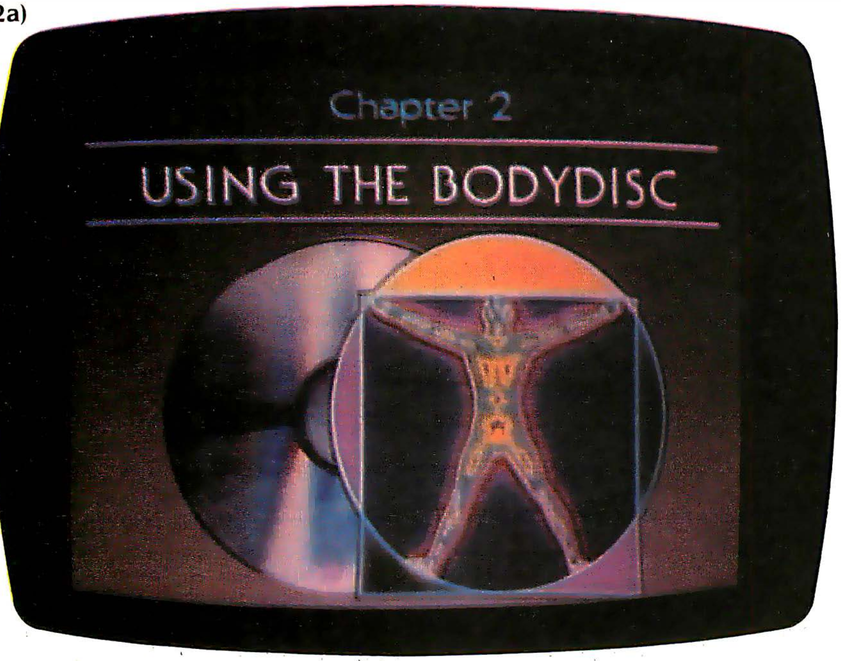


Photo. 2a: *The "Bodydisc" is an experimental project designed to test the feasibility of delivering encyclopedia information via a laser disc. The disc incorporates several user aids and orientation features, such as this chapter on how to use the disc.*

(2b)

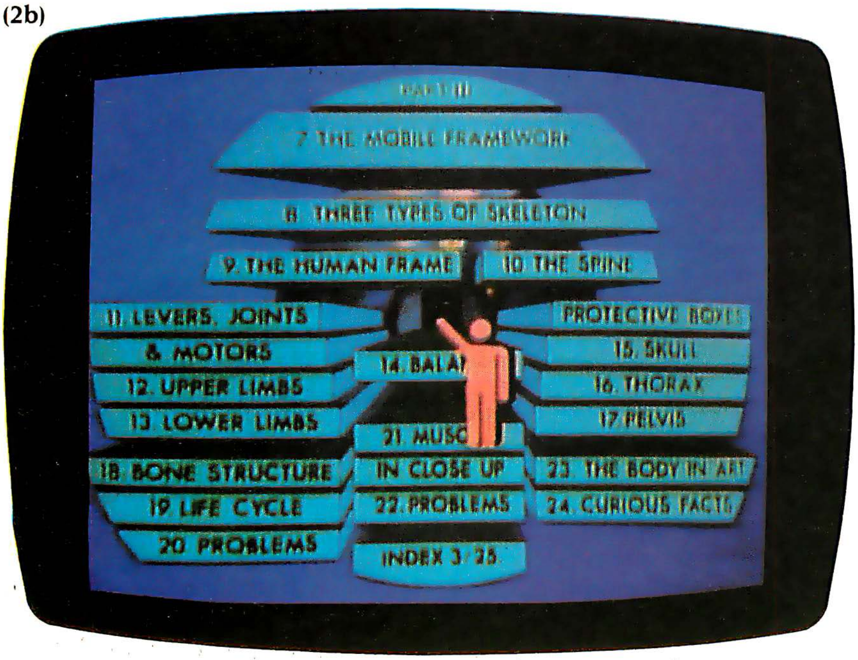


Photo 2b: *Another orientation feature of the "Bodydisc" is the inclusion of several strategically placed "You Are Here" screens.*

line (approximately 330 words). By contrast, the printed AAE contains 1500 words per page, and pages can be viewed two at a time. Clearly, current video-display technologies are capable of only the most myopic view of a large text database, which is why it is all the more important to be able to rapidly shift the view, to be able to browse and move around in an article quickly and easily.

But there is a need for other orientation tools, such as sequential numbering of article pages (which Dow Jones News/Retrieval has) as well as individual numbering of pages (which CompuServe has).

A recent study of a group of eighth-graders' use of the videotex AAE produced some interesting findings. While the students searched for articles and moved around in them with varying degrees of proficiency, they confined their activities to *finding* information rather than *using* it. They actually read and manipulated the information later as printouts, which could be studied at leisure, marked up, and incorporated into their research projects. In fact, I suspect that many of our users who have access to a printer do their serious reading in ink-on-paper form.

This doesn't mean that no one reads text from the screen. Graphics-oriented videotex systems, such as Viewtron, are based on the assumption that subscribers will read from the screen. This is fine for news summaries. But the real utility of an electronic encyclopedia won't be realized until people can access, manipulate, and reorganize significant amounts of information *electronically* using such powerful information tools as word processors, database managers, and graphics programs.

Electronic Knowledge Land

Grolier is working on some of the refinements I have been describing. We believe that, having freed encyclopedia information from the artificial constraints of the alphabet and the physical constraints of the book, we should be able to reshape and reorganize that information. We want to put it to new uses. We want to create a reference tool that can interact with other information tools. Additionally, we're trying to build a conceptual framework—an outline of knowledge—for intellectual pursuit and stimulation. At present, this new "knowledge land" is largely uncharted, although major landmarks are known. We hope that videotex systems will have the navigational tools to explore it fully, and that software producers will have

(continued)



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(2c)

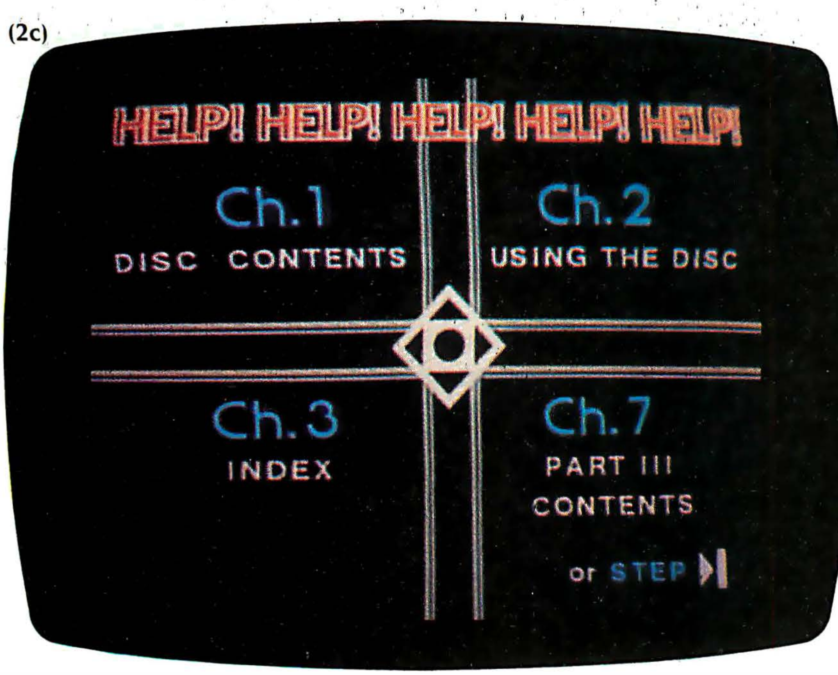


Photo 2c: *This photo shows one of the Help screens on the "Bodydisc." The user can get additional assistance when needed.*

created the manipulation tools to exploit it fully.

A Videodisc Encyclopedia

The videodisc is another interactive medium that we believe is applicable to encyclopedia information. The ability to randomly access any frame, combined with the disc's dense storage capacity (54,000 frames per side on a laser disc) and its inherent audiovisual properties, make it a particularly powerful publishing medium.

As part of a joint venture with Longman, a British publisher, Grolier recently produced a pilot disc. The pilot was developed as a test vehicle to determine how the organization, content, and audiovisual treatment of encyclopedia material might best be accomplished.

Long before the pilot went into production, we had concluded that we would need a lot of discs to encompass all the information contained in a general encyclopedia. This led us to ask ourselves how each disc should be organized so that it could be both a stand-alone information resource and a part of an integrated series. We decided to organize each disc around a specific theme or subject area. The pilot is part of what will eventually be a two-sided disc devoted to the human body (see photos 2a through 2c).

Each thematic videodisc will be a self-contained information resource. The discs will not attempt to be the equivalent of a printed reference work. Rather, each disc will "illuminate" knowledge areas, conveying through audiovisual means only the essence of a subject.

Designed for use with a standard consumer laser videodisc player under normal keypad control, the discs will become considerably more versatile resources under microcomputer control. While the number of combined microcomputer/videodisc applications has increased substantially in the last two years—applications that include training, point of purchase, education, and games—there are few truly "generic" discs for which software can be written.

Grolier is developing two electronic databases, one in text form and one in audiovisual form. These two databases are being developed separately so that each can take advantage of the separately developing markets for on-line/videotex and videodisc products. But both databases will ultimately be brought together (although whether through telecommunications or local mass storage is yet to be determined). The result should be an innovative informational/educational resource: an encyclopedia that is appropriate to the media and appropriate to the times.■

TELEVISIONS AS MONITORS

BY KEN COACH

An introduction to a new generation of television receivers that double as monitors

SOME HOME COMPUTERS will operate quite nicely with just a normal television set, as you probably know if you've usurped the family TV or dug out the old black-and-white set from the basement. But sooner or later, you'll probably want to upgrade to a monitor. If you are using your computer for word processing or 80-column applications, a television set just can't give you the same resolution that a monitor can.

If you are interested in using your computer only to display text or data, you'll need a monochrome monitor for an 80-column screen. You can choose green, amber, or black-on-white video displays to help reduce eyestrain.

If you use your computer for more varied tasks, however, and if you are interested in other television peripherals, such as a videocassette recorder (VCR) or videodisc, you probably will be considering an upgraded color system.

COMPUTER RESOLUTION

Resolution begins in your computer's ROM (read-only memory) and depends on how large a dot matrix the ROM character generator uses to produce letters or graphics. The matrix can vary from 35 dots, which produces a character 5 dots wide by 7 dots high, up to a matrix that contains more than 300 dots. The more dots, the higher the resolution and the more clearly defined the characters. One of the most common arrays is a 63-dot matrix (7 by 9).

When the matrix for each character is displayed on a TV or monitor, its sharpness can depend on the following factors:

Bandwidth is the rate at which the screen is redrawn (or refreshed). It is measured in millions of cycles a second (MHz). Television sets normally have a bandwidth of about 4.5 MHz, while monitors can have bandwidths as high as 50 MHz. In fact, the actual bandwidth of most TV receivers is not more than about 3.8 MHz, which is adequate for the evening news but not really good enough for a computer display.

As a rule, you can expect to get about 80 horizontal lines of resolution for every MHz of bandwidth. Remember that a TV screen has 525 lines but that the viewed image amounts to only 343 lines.

TV producers make sure most of the action takes place in the center of the screen because TV manufacturers have a built-in "overscan" that compensates for the deterioration of some of your set's parts, which might make the picture smaller than the screen. Unfortunately, that further reduces the number of lines available for computer use.

Resolution can also depend on the way a TV or monitor interlaces its picture. The 525 horizontal lines on a TV screen (called the raster) are ideally broken down so that each "frame" on the screen is made up of two scans of 262½ lines each. In order for that to work, each of the two fields must be perfectly interlaced so that the lines of one fall exactly between the lines of the other. Thirty frames are drawn on the screen each second, and each one has two fields.

Not all TVs can accommodate an interlaced 525-line raster (nor can all computers, for that matter), so many units use a 260-line noninterlaced raster that lowers the quality of resolution.

A monitor with a high number of scan lines would still be limited by, for example, an Atari computer that sends out 191 visible scan lines.

If you use a 35-dot matrix (5 by 7), it will take at least 7 scan lines to draw the character. When you add space between lines and perhaps an underline option, it can take 10 or 12 lines to draw the character. That means that a 260-line raster can display only about 20

(continued)

Ken Coach has been a newspaper and TV journalist for 14 years. A cofounder of Orcavision Computer Software, he is now an independent computer writer and consultant. He can be reached at 228 East 13th St., #21, New York, NY 10003.

lines of characters on the screen.

Color convergence is yet another aspect that can affect resolution. Convergence is the degree of accuracy with which each of the three color guns shoot the electron beam onto the screen. If you look closely at the screen and detect little color halos or rings around some characters, the convergence needs adjustment.

The other contributor to resolution is *dot pitch*, the space between the red, green, and blue phosphor dots on the screen.

Dot pitch is measured in millimeters (mm), and the smaller the pitch, the more dots are on the screen and the better the resolution. A high-resolution color monitor may have a dot pitch under 0.50 mm, but the dot pitch of an ordinary TV can be as much as twice that.

High resolution is obviously alluring, but don't be seduced by it. Make sure your computer can produce the resolution to take full advantage of the monitor you have in mind; otherwise, you may be throwing away money.

RGB vs. Composite

The letters "RGB" are kicked around quite a lot when people discuss monitors these days. They mean, of course, "red, green, blue," the basic colors that all TV sets use to produce a color picture.

The color signal standard known as "composite" video as defined by the National Television System Committee (NTSC) allows for the transmission of red, green, and blue together as one signal that is then split with a device known as a "comb filter." In early TV sets, the signal coming in was "chopped" and alternately diverted to red, green, or blue phosphor dots.

Some composite sets, such as the Sony Trinitron, use three separate electron guns to shoot the separate red, green, and blue signals, which is a great improvement, but there is still just one composite signal coming into the set. With an RGB monitor, however, each of the three colors has its own signal to control the electrons hitting the video screen. The result is a sharper image and more clearly defined color intensities.

Two types of RGB systems are currently in use: *analog* and *digital*. The analog signal is delivered directly to the video gun, illuminating the phosphor screen dots in sync with the raster-scan pattern. This produces an almost unlimited variation in colors and brightness levels.

A digital RGB system is more restricted in its color range. Instead of sending the actual signal, a digital system works through a microprocessor and sends the instructions for the color scan.

To date, most home computers must be adapted to work with an RGB monitor. However, some computers, such as the IBM PCjr, are equipped with built-in RGB capability. As a result, some monitors and TVs are being produced with both composite and RGB inputs to allow the use of either system.

Monitors vs. Televisions

Since monitors seem to do less than television receivers, you might wonder why they cost more. The reason is that a monitor is actually designed to do more than a normal TV set: it has been developed specifically to display signals from your computer or video recorder or videodisc player. In fact, some units let you integrate functions from one of those media to another. You can use your computer, for example, as a character generator to produce text that can be superimposed on a VCR image.

Monitors are likely to have a much greater bandwidth than receivers, which means better resolution. They are generally built to more exacting specifications, since there is not the automatic loss of quality inherent when a video signal is broadcast.

Another advantage is that monitors often have controls that TV sets lack or controls in more convenient locations for frequent adjustments. Some new color composite video monitors, for example, have color-kill switches to produce a monochrome display to make text reading easier or a reverse-video switch to produce a black-on-white display.

Brightness and contrast controls on monitors are generally located at the front of the unit, and some monitors have centering controls to adjust the picture.

Some new monitors, following the lead of the stereo industry, are being billed as "component" televisions. In fact, component TV will probably start to take off when stereo TV broadcasting becomes more widespread.

Several manufacturers are working on stereo TV tuner/receivers that will be out late this year. Another approach is a TV tuner that would use a standard home stereo system to amplify the stereo signals.

Teletext and videotex services providing everything from banking to televised catalog shopping at home are expected to increase in the next few years as well. That will increase demand for higher-quality home monitors.

While an RGB monitor provides the best resolution and can operate with some computers, video players, and cable systems, composite video is still an option.

Picking up standard broadcast signals still requires a composite video system. As a result, many monitors are being made with the option of RGB or composite video to allow for a wider variety of use.

Future Technology

One of the problems with any computer-related technology is that you can't tell if it will be obsolete within a year or two. Just as the mouse seems ready to change some of the basic concepts of home computing, a new technology will radically change our expectations for a computer monitor. Manufacturers of a flat-screen TV technology, for example, are about two years away from making serious inroads in the computer field. Although some portable computers have come out with flat displays, they provide only a few lines rather than a full screen.

One approach, the liquid-crystal display (LCD), works on the principle of varying the electric current applied to crystals, which makes them either clear or opaque. An LCD depends on light being reflected back from the crystals. It does not produce light on its own and therefore can be used only in a well-lit area.

A different sort of flat-screen application, the electroluminescent display, consists of a layer of zinc sulfide and manganese between two glass panels that have extremely thin, closely spaced wires imbedded in them. An electric current can produce pixels where a horizontal and vertical wire intersect.

(continued)

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So far, flat-screen displays are being used mainly for text. Their major disadvantages are limited resolution and high cost, problems manufacturers are working to solve.

Still another approach involves redesigning the video display rather than finding a replacement for it. The Sony Watchman was a significant development in the miniaturization of a screen, but more significant to computer applications may be the recently released pocket television from Sinclair Research in England.

The Sinclair pocket TV is not presently suitable for computer applications because of its size, but the technology holds promise for the future.

The Sinclair TV uses a cathode-ray tube with an electron gun on the side rather than the rear, as in conventional TV picture tubes. The company is now working on a color version of the pocket-size TV and is also developing larger flat-screen technology. The so-called "picture frame" display that's thin enough to hang on a wall may have great potential for computer applications.

A Monitor Sampling

It would take a good-size book to compare the many monitors and television sets on the market today. Even a straight listing of specifications is deceiving, since our perception of color is highly subjective.

The best approach when shopping around is to look at as many different monitors as possible, preferably hooked up to your own computer or one like it. Monitor size, features, and price range are all personal decisions. What follows is a sampling of some of the monitors that are presently available.

Panasonic

Panasonic has split itself into two companies: an industrial division aimed at business and high-end computer monitor use and a consumer division that makes televisions for the home (including computer, VCR, and cable use).

The newest product from the industrial division is the DT-H103 monitor, which became available in April at a suggested price of $750. The 10-inch (diagonal) display is meant to be a desktop monitor for IBM, Apple III, NEC, or Panasonic's own "Sr. Partner" computers.

The DT-H103 uses a high-resolution screen and can be used with either composite or RGB input. The monitor also has a reverse-video switch that allows black-on-white word processing and a centering lever to adjust the picture.

Picture quality is exceptional, and the monitor is appropriate for any mass-market computer now available. The 80-character, 25-line screen has a resolution of 760 by 570 pixels. An etched screen virtually eliminates reflected glare.

Some people will probably find the 10-inch screen too small for comfort. The company plans to release a 14-inch version this summer, but it will not have quite as good resolution. Panasonic officials say that increasing picture quality is expensive and that, since the demand is still not that high, the cost of an equivalent 14-inch unit would be prohibitive.

For someone with an inexpensive home computer, Panasonic offers a more modest monitor for about $400. Though this unit has only a 40 by 25 character display, one feature will be welcomed by anyone who has tried to use a word-processing program on the Commodore 64—a color-kill switch that makes for a sharp black-and-white display for easier text reading.

For a complete home TV/VCR/computer system package, Panasonic's consumer division offers the Omni series. These sets are intended to compete with Sony's Profeel product line. The most interesting unit in the series is the CTF-1465R, which will retail for about $680. It has a built-in TV tuner as well as VCR, cable, computer and even IBM interface connections. You can choose between composite and RGB signals. It also has remote control, an on-screen clock, and even a timer to turn off the late show after you nod off.

Meant as a multiuse receiver monitor, it has a very good picture with a 0.42 mm dot pitch and more than 350 lines of horizontal resolution in the composite mode.

You might prefer to wait until the 1495 monitor is released this summer. Although that unit is essentially the same as the CTF-1465R without a tuner, it also has the ability to display teletext and videotex.

Sony

Any discussion of top-of-the-line monitors for the home market must include the Sony Profeel series. Over the years, Sony has built a reputation of trustworthiness that results in many people buying its products without even considering anything else. Sony products have been among the best since the company's Trinitron series popularized a single-gun approach to composite video.

The latest models in the KX monitor series take advantage of the Trinitron technology and add both analog and digital RGB capability. In addition, the company has released an interface accessory so that the monitors can be used with an IBM PC.

The monitors, called "component TVs," are designed to provide access to computers, videodisc players, VCRs, cable TVs, and future stereo broadcasts.

Without tuner, interface, or stereo speakers, the 19-inch model costs about $850 and the 25-inch set costs about $1500.

The 19-inch monitor has an excellent picture with more than 350 lines of horizontal resolution on its composite input and more than 450 lines on the RGB input. The monitor will accept digital and analog RGB signals, which makes it capable of accepting teletext or videotex signals.

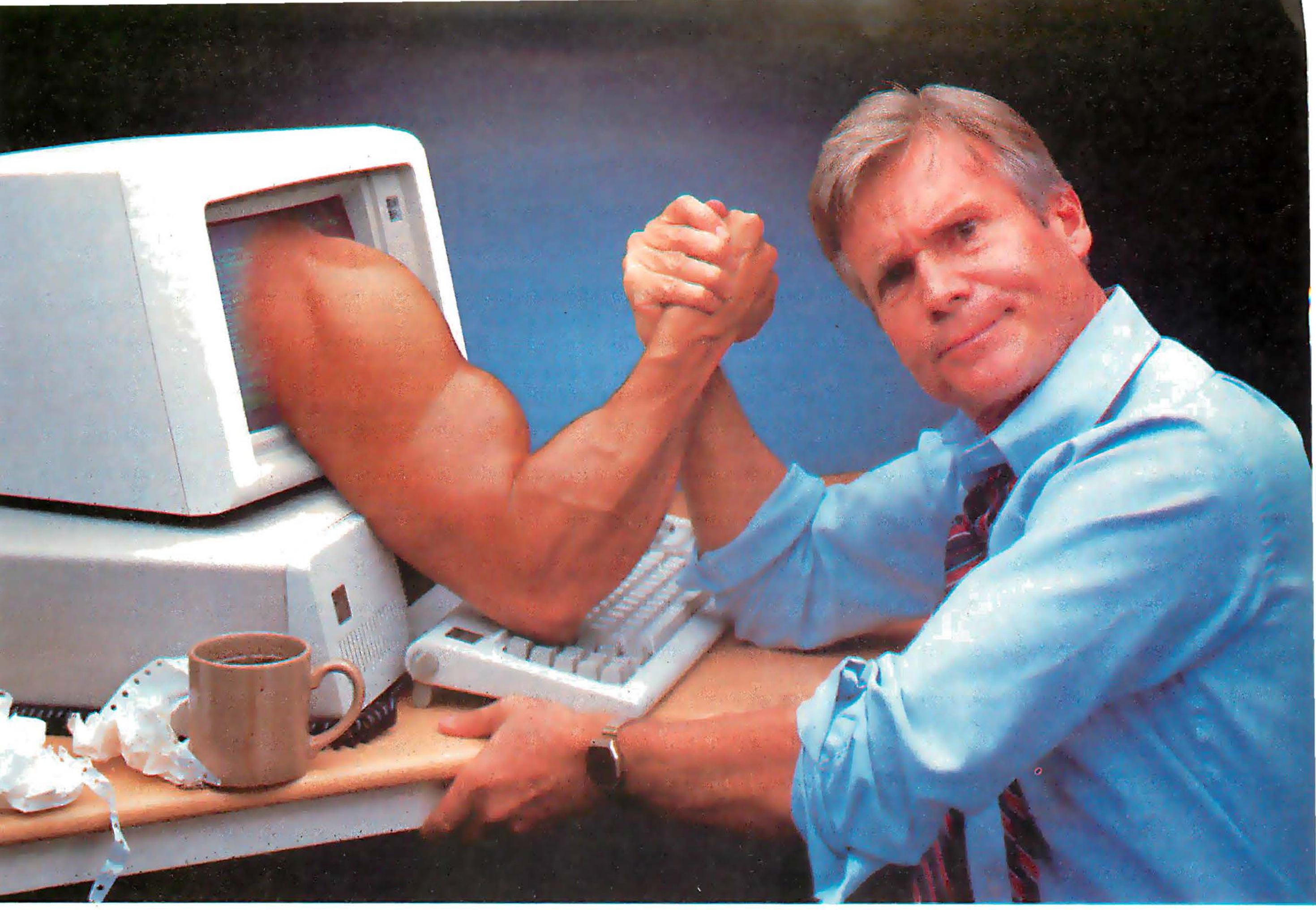
The unit has a built-in stereo amplifier with 5 watts per channel stereo output for external speakers. Picture contrast adjusts automatically to compensate for changes in the video signal.

The monitor is a good all-purpose unit for someone who might want it to display a spreadsheet program one day and the latest VCR program the next. If your taste is more to the VCR and videogames, though, you might prefer the 25-inch monitor. A larger screen, however, can be hard on the eyes if you plan to do a lot of programming or word processing.

Teknika

One Japanese monitor manufacturer preparing to increase its impact on the American market is Teknika. The company presold all of its initial stock of the MJ-22, which is a 13-inch RGB/composite monitor.

(continued)



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The first of a series of monitors that Teknika plans to release, the MJ-22 is priced at $539. It has a 0.50 mm dot pitch and 320 lines of resolution in the composite mode. The Teknika monitor is compatible with IBM and Apple RGB boards and with virtually all home computers in the composite mode. For its price, the Teknika is an excellent monitor and probably more than adequate for most home computer users.

By the end of this year, the company will release a high-end monitor with greater resolution and a 0.31 mm dot pitch. That unit, the MJ-40, will have a suggested retail price of $650.

Although other companies deny it, Teknika officials predict that monitor prices will come down as consumer interest in the product grows and production increases. The other factor, of course, is pressure from competitors to lower prices or improve quality. Happily for anyone who may be in the market for a monitor, Teknika may be starting to apply that pressure.

NEC

Anyone who has already considered purchasing a high-quality monitor is familiar with NEC. Recently, the company brought out two new monitors in what it calls its "91" series.

The CM-1991A and CM-2591A are, respectively, a 19-inch RGB monitor that sells for $850 and a 25-inch RGB monitor for $1100.

These monitors can be used with either analog or digital RGB signals. They have a dot pitch of 0.70 mm with 370 lines of horizontal resolution and are designed to be compatible with a number of computers, including the IBM PC. A built-in intensity control allows the monitors to take advantage of the color potential of the IBM PC.

In addition, the circuitry will let users combine a video source with characters or graphics created by their PCs. This could be used, for example, to create titles and superimpose them onto a VCR recording.

NEC also has a 13-inch receiver with RGB capabilities. It carries a suggested list price of $599 and has a dot pitch of 0.50 mm with 330 lines of horizontal resolution. The CT-1305A offers the same control functions as the more expensive units and wireless remote control.

Proton

Proton's 600M, a composite monitor, proves that a high-quality color monitor doesn't have to be RGB.

The 19-inch color unit boasts better quality than conventional component TV. According to company specs, the 600M has large filter capacitors and a stable power supply that reduces fluctuations in the DC voltage. The result is a truer black that produces better color. The Proton also claims to have less overscan, about 5 percent compared to 20 percent on other models.

Of interest to computer users is the Proton's linearity and convergence. The 600M has more windings than is usual on the wire coil deflection yoke. That means stronger, more precise magnetic control can be used to deflect the electron beams for straighter lines near the perimeters of the picture tube. The same yoke design helps convergence, and the company says color fringing is eliminated.

The 600M has a horizontal resolution of 370 lines. Company officials are quick to point out that it also has a video frequency response of about 4.7 MHz. Broadcast video generally drops off at about 4.2 MHz.

The 600M retails for about $650, and, although it has no special controls or connections for computer use, it would fit well to a component system containing a computer. Proton also makes a tuner and a monitor/receiver.

For those who simply must have RGB, Proton recently released the 602M for $1050. It is identical in performance to the 600M but is a 25-inch color monitor. In addition to an RGB input, the 602M has a more powerful stereo amplifier, separate video/audio inputs, and a video output.

And More

Presently, 20 or so manufacturers make color monitors for computer use, and even more will soon enter the market. A monitor is one of the fastest selling computer peripherals, and increased competition may mean lower prices and new technological developments.

Some other representative manufacturers of RGB and composite color monitors include Amdek, Conrac, Electrohome, Sakata, Sanyo, Taxan, USI, and Zenith. ■

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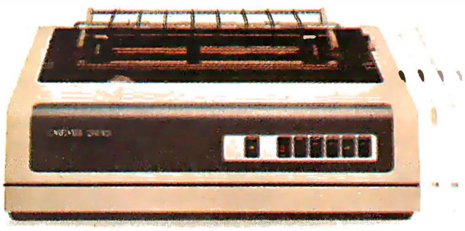
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BY CY TYMONY

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SHORTLY AFTER I acquired a VCR (videocassette recorder), a Realistic Model 10 with one-event programmability, I became frustrated playing the morning "programming game." Should I record this show or that show? I felt somewhat limited having only one programming option, especially when I compared the capabilities of more expensive systems that can be programmed for multiple events on different channels. I decided I would control my VCR with my TRS-80 Color Computer.

This project is designed for VCRs that have *varactor* tuners. You can recognize this type of recorder by the way you change its channels. If you turn a dial to select a channel, then your VCR has a dial (or *turret*) tuner. If you use soft-touch control switches, a keyboard control, or an up/down-counter control, then your VCR has a varactor tuner. For our purpose of controlling a VCR's functioning via a computer, the varactor-tuned unit is required because it uses an electrical signal instead of physically moving switches to select channels. (For more information on VCR tuning techniques, see references 1 and 2.)

INTERFACE HARDWARE

By connecting external switches in parallel to the VCR's record, stop, and channel-selection switches (as shown in figure 1), you can control the VCR's functions with LM567 tone decoder ICs (integrated circuits). If your VCR has a remote control, then you can wire the switches to the remote control's switch contacts. The circuit shown in figure 2 uses the sound output from a TRS-80 Color Computer to activate the tone decoders, which turn on reed relays wired in parallel to the VCR's control switches. (Table 1 contains a list of parts you'll need to build the circuit.) The tone decoders and the reed relays provide total electrical isolation between the computer and the VCR. The tone decoders can be set to respond to any frequency from 0.01 Hz to 500 kHz. (For more information on 567 tone decoders, see reference 3.)

Inside the 567 tone decoder IC, a current-controlled oscillator operates at a frequency set by the values of the potentiometer connected between pins 5 and 6 and the value of the capacitor connected to pin 6 and ground. The input signal (in this case the computer's sound output) and the internal oscillator are fed to two phase detectors. When the internal oscillator frequency is within about 14 percent of the input signal, the output pin 8 sinks up to 100 milliamps to ground.

To tune the 567s, write a short program to make your computer produce a tone, and tune one of the tone decoders to this signal. Check the leads of all the other tone decoders used in the circuit to make sure they do not turn on to this tone. Repeat this procedure until every tone decoder in the circuit will turn on only to its own individual sound from the computer. For very low frequency tones under 800 Hz, the tone decoder may take a full second to lock on to a signal. Be sure that the duration of the sound command in your program is long enough for the tone decoder to

(continued)

Cy Tymony (POB 2387, Beverly Hills, CA 90213) attended the University of Wisconsin and works as a technical writer. His latest book, 99 Fun-to-Make Electronic Projects, *was published by Tab Books. He is currently developing projects for low-cost computer-controlled video editing and special effects.*

lock on the signal and actuate the reed relay.

The tone decoder is fine-tuned by adjusting the potentiometer connected between pins 5 and 6. For high-frequency operation, you may substitute another value for the capacitor connected to pin 6 and ground; also, see the data sheet that comes with the 567 tone decoder IC for more information.

The reed relay uses a small reed switch that is surrounded by a coil of wire. When current is applied to the coil, the contacts in the reed switch close, which completes the circuit. Because there is no direct connection between the coil and the contact switch, complete electrical isolation is obtained. A power supply for this project is shown in figure 3. Table 2 lists the parts you'll need.

If your computer has an external sound output, then send the signal to the tone decoders with a 10-μF (microfarad) bypass capacitor. If the computer's sound output is not externally available, you can tap the signal just before it enters the computer's RF (radio-frequency) modulator, if it has one. If the power level of the sound output is too low, you can increase it by using an LM386 amplifier IC to build it up to a usable level (see figure 4).

The Control Program

The control program, shown in listing 1, keeps track of time. When the "start" time matches the "present" time, the computer produces a tone that selects the programmed channel and also produces another tone that momentarily closes the record switch contacts to start the VCR recording the event. When the "end" time matches the present time, the computer closes the stop switch contacts with another tone. When in counting mode, most personal computers are between 1 and 5 percent accurate within a 24-hour period. This is good enough if you set the start and end times a few minutes before and after the scheduled times of the programs you want to record.

Lines 5 to 75 request input data about the event to be recorded (channel, start time, end time). Line 80 requests present time to start the computer clock. Line 90 produces a one-second delay for the clock. (This is based on the TRS-80 Color Computer's internal clock

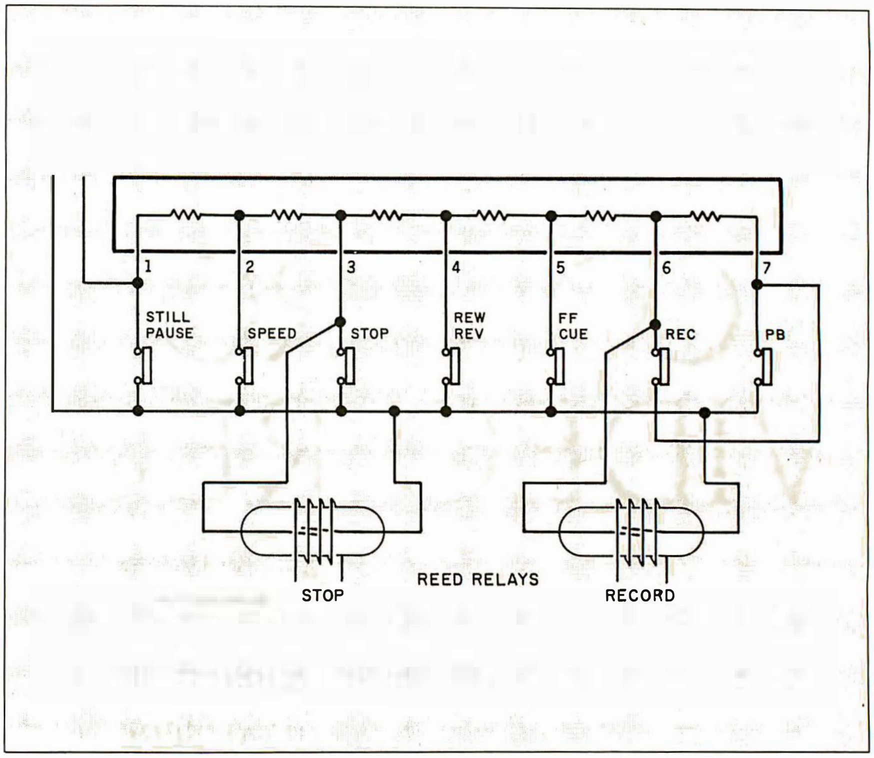


Figure 1: *An example of external switch connection.*

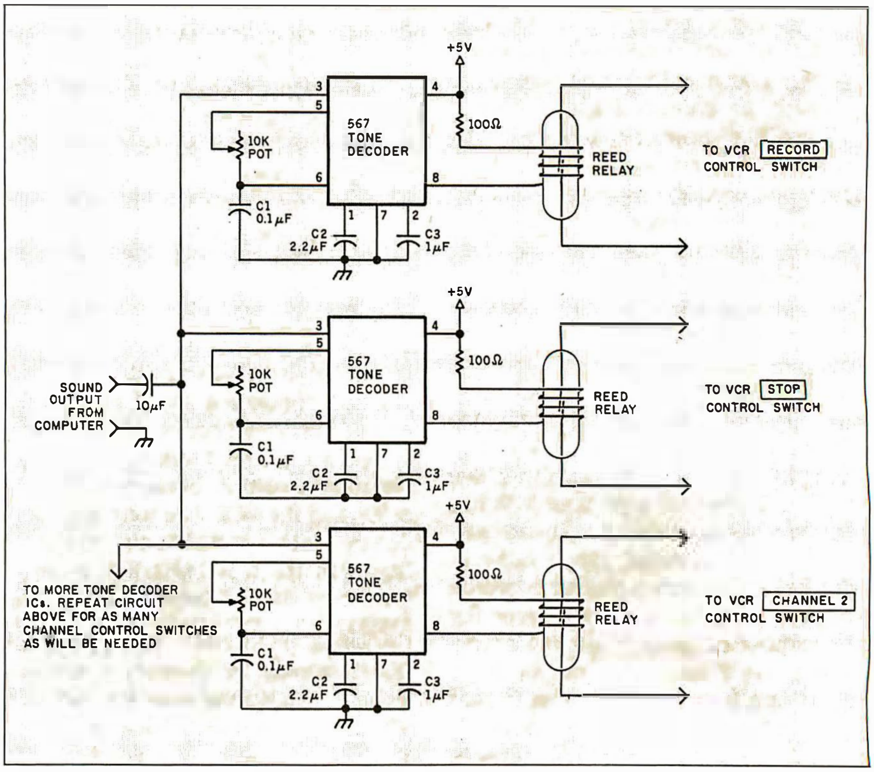


Figure 2: *The computer-VCR interface circuit.*

Table 1: *The parts needed to build the computer-VCR interface. The number of parts required depends on the number of channels you need to select.*

Part	Radio Shack Catalog Number
567 tone decoder IC (as many as needed)	276-1721
25k-ohm potentiometer	271-335
1-F capacitor	272-996
2.2-F capacitor	272-135
10-F capacitor	272-1013
16-pin DIP jumper ribbon cable	276-1976
Reed relays	275-232
Perfboard	276-1394
IC sockets	276-1995

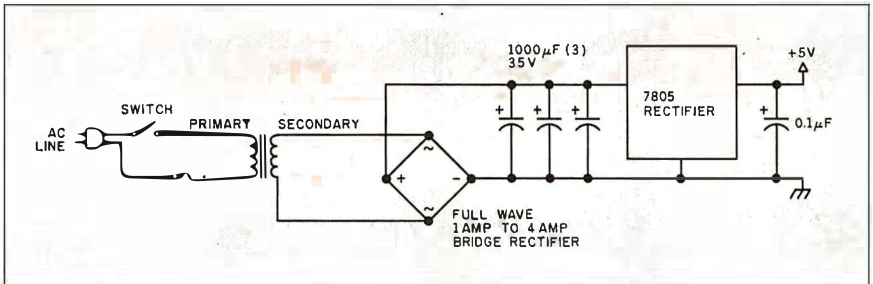


Figure 3: *The regulated power-supply circuit.*

Table 2: *Power-supply parts list.*

Part	Radio Shack Catalog Number
3-amp transformer	273-1511
Full-wave bridge rectifier	276-1171
7805 5-volt regulator	276-1770
1000-μF capacitor	272-1018
Fuse holder	270-739
Fuse	(capacity depends on number of components)
Perfboard	276-1394
Cabinet	270-224
AC cord	278-1255

Note: A ready-made power supply is available from Radio Shack (22-127). You will still have to use the 7805 5-volt regulator to drop the power down to a constant 5 volts.

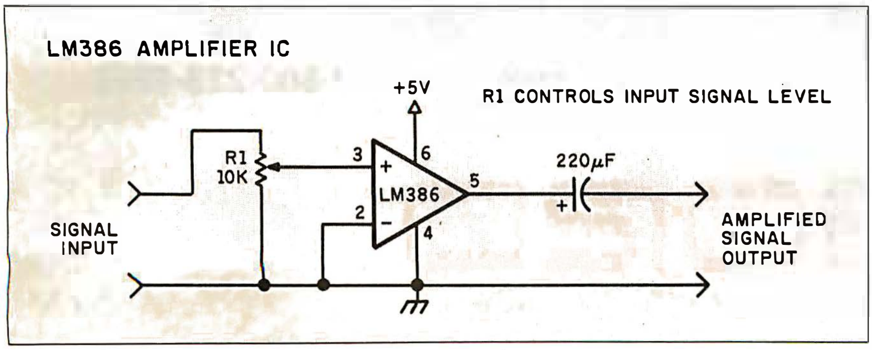


Figure 4: *The sound-amplifier circuit.*

speed. Other computers would use a different delay sequence, which you can find through experimentation.) Line 100 compares the start time of event one with the present time; if they match, the computer selects a channel by adding the channel number to 100 and producing a tone. It also produces a different tone to actuate the record switch on the VCR. Line 110 compares the end time of event one with the present time; if they match, it produces a tone to actuate the stop switch on the VCR. Lines 130 to 180 are reserved for more event data. Lines 181 to 300 reset the clock.

Counter-Tuner VCR Procedure

With this method, a reed relay is wired in parallel to the channel "up" switch on the VCR. A tone decoder IC is connected to the reed relay that can be turned on by a unique tone from the computer's sound output.

The computer selects the first event's channel by producing the number of tones needed to reach the desired channel. For example, if the VCR is set on channel 2 when it is first turned on, and the first event to be recorded is on channel 5, then the computer produces three tones with pauses of one-half second between the tones. For the next event, the computer sounds the number of tones equal to the difference between the present channel and the desired channel.

The program for selection of channel 5 could be:

```
IF AB=H AND AC=M THEN SOUND
100,1 : FOR I=1 TO 190: NEXT I:
SOUND 100,1 :FOR E=1 TO 190:
NEXT E : SOUND 100,1 : SOUND
150,1
```

Keyboard-Tuner VCR Procedure

With this method, every number on the keyboard has a reed relay wired in parallel to it. A tone decoder IC is connected to each reed relay that can be turned on by a unique tone from the computer's sound output.

The computer produces two different tones (one-half second apart) that represent a channel selection. To program channel 4, the computer sounds a tone for tone decoder 0, pauses for one-half

(continued)

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Listing 1: *The* VCR *control program.*

```
5   PRINT "CHANNEL":: INPUT AA
10  PRINT "START TIME H,M,S":: INPUT AB,AC,AD
15  PRINT "END TIME H,M,S":: INPUT AE,AF,AG
20  REM LINES 25 TO 75 ARE RESERVED FOR MORE EVENT DATA
80  PRINT "PRESENT TIME H,M,S":: INPUT H,M,S
90  PRINT H,M,S: FOR T= 1 TO 800: NEXT T : S= S+1
100 IF AB = H AND AC = M AND AD = S THEN SOUND (AA+100),1: SOUND 150,1
110 IF AE = H AND AF = M AND AG = S THEN SOUND 200,1
130 REM LINES 130 TO 180 ARE RESERVED FOR MORE EVENT DATA
181 IF S> 59 THEN GOSUB 200
182 IF M> 59 THEN GOSUB 250
183 IF H> 23 THEN GOSUB 300
184 GOTO 90
200 S = 0 : M = M+1 : RETURN
250 M = 0 : H = H+1 : RETURN
300 H = 0 : RETURN
```

second, and then sounds a tone for tone decoder 4 (04).

The program for channel selection would be as follows:

IF AB=H AND AC=M THEN SOUND 80,1 : FOR Z=1 TO 390 : NEXT Z : SOUND 90,1 : SOUND 150,1

Other Interfacing Methods

Sound output is just one of the many possible interfacing techniques that can be used to control a VCR with a microcomputer. You can use a parallel port, a serial port, or a cassette output port to relay data to an interface device. Since the computer's only function is to count the time and momentarily send an output signal, even a portable or a pocket computer can be used to control a VCR with a phototransistor placed near its liquid-crystal display to sense screen changes.

You'll probably want to obtain an inexpensive personal computer for this purpose; many are available, including the Timex/Sinclair 1000, the Texas Instruments 99/4A, the TRS-80 MC-10, and the Commodore VIC-20. (For more information on interfacing microcomputers to control external devices, see references 6 and 7.) After using the interface for a few days, the biggest problem you will be confronted with will probably be obtaining enough videotape to satisfy your programming needs. ■

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ACKNOWLEDGMENT

The author wishes to extend special thanks to Mario Gonzales for his contribution to this project.

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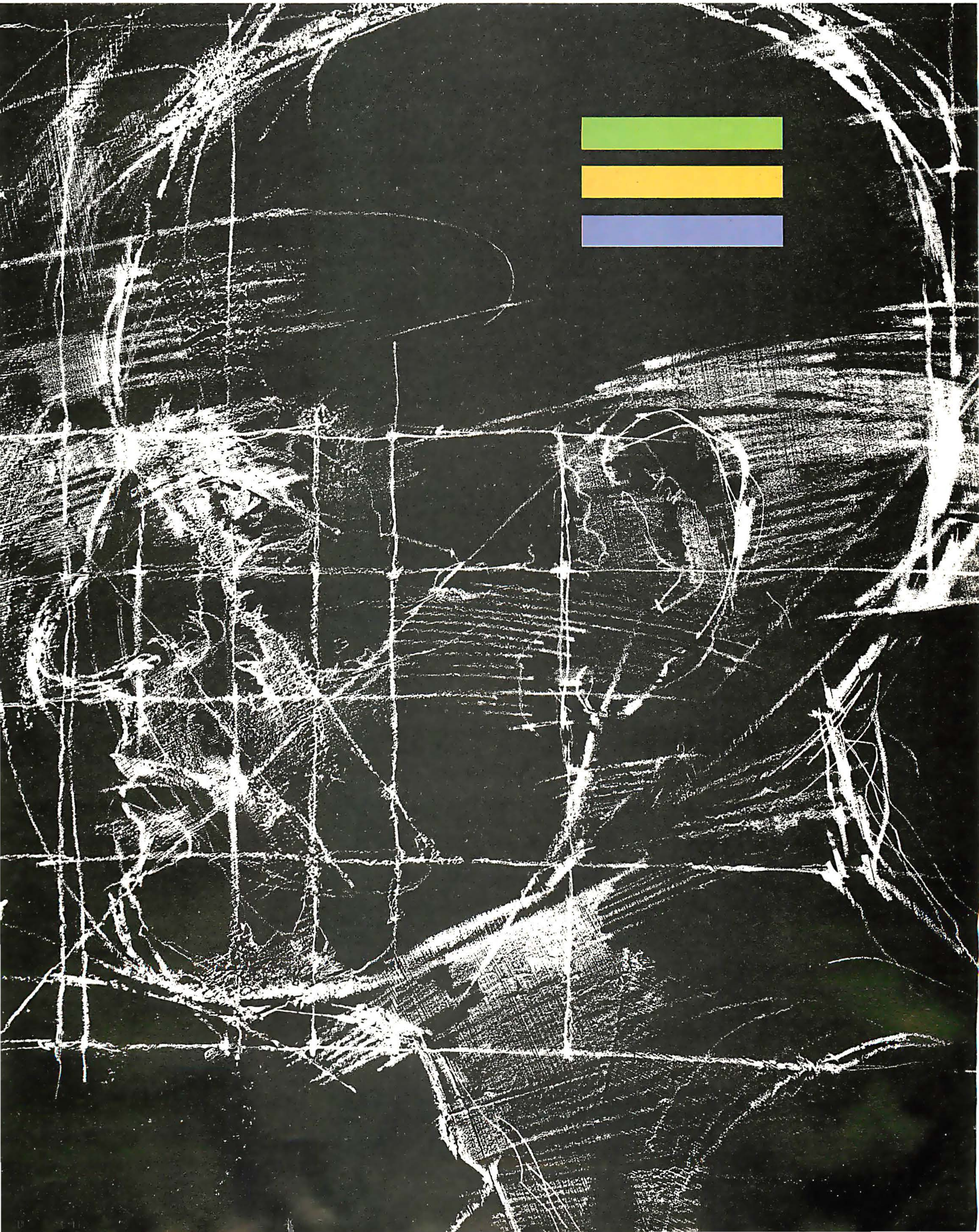
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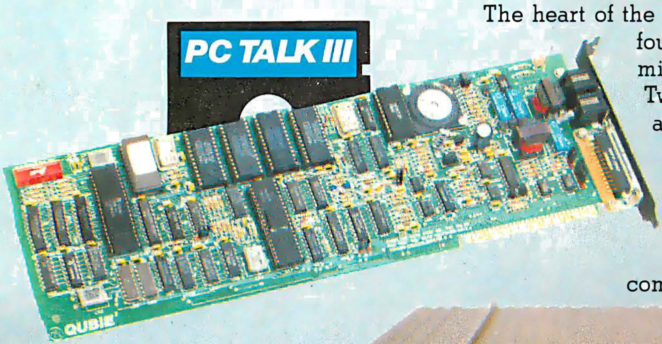
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VIDEODISCS AND COMPUTERS

BY STAN JARVIS

Hardware, formats, and interfacing

THE EMERGENCE OF the home videodisc player as a storage medium for images has focused the attention of businesspeople and programmers alike on the advantages of linking realistic video with computer graphics and programs.

The videodisc itself is not new; its history begins in the early 1880s when Paul Gipkow received the first videodisc patents in Germany. About this time, Alexander Graham Bell produced optically recorded 12-inch audiodiscs using a solar-powered ink-jet modulating device in Washington, DC. Bell licensed his audio-recording patents to Thomas Edison, who introduced wax-cylinder audio players. They were soon replaced in the marketplace by 12-inch audiodiscs developed by Deutsche Grammophone. Edison later founded Westrex to develop talking movies, matching the running length of a reel of movie film to a 12-inch audiodisc spun at 33⅓ revolutions per minute (rpm).

England's John Logie Baird created a mechanical scanned video system in the late 1920s. The Baird television used 12-inch pressed-wax audiodiscs containing video test signals to assist in its daily adjustment. The British Broadcasting Corporation (BBC) provided an even greater advance a few years later with the introduction of an electronic scanning television system, replacing Baird's technology.

By 1940, German radio stations were using innovative magnetic audio-recording technology. In the United States, Ampex Corporation used parts carried into the country after World War II to develop its first magnetic-tape audio recorders. Later, Ampex turned its attention to developing the first successful videotape recorders, and Westrex developed the first stereo records.

The modern videodisc is a hybrid, the result of crossing a number of technologies. Special recognition is due 3M Corporation, which funded the first working videodisc players in the early 1960s. The company used silver-halide media read optically with a lightbulb illuminating source. Initially, the company's signal-pickup system decoded considerable "noise" (or interference) from adjacent video tracks. However, because there is little difference between consecutive movie frames (except for the movement of people or objects), 3M reasoned that image noise would seem reduced by spinning a videodisc at an even number of frames per revolution, or 1800 rpm. The company's patent on this concept in the early 1960s immediately prompted industry leaders to view the videodisc as a potential video-image storage peripheral for a computer system.

The forces behind the development of video are distinct from influences that led to modern personal computers. Characteristics such as scan rates, interlace, and data formats were all established long before the emergence of popular cathode-ray-tube computer systems. Video data can be sourced from broadcast transmissions, videotape, videodiscs, or from digital frame buffers. One need only consider the amount of RAM (random-access read/write memory) allocated to a typical screen control function in a personal computer to appreciate the difference between video requirements (in excess of 300K bytes for a single frame buffer) and computer display requirements. Developers of video systems usually avoid the need for massive amounts of screen memory by refreshing the cathode-ray tube directly from the video source's incoming data stream. Practical relationships between videodisc players and computers have been driven by two forces, broadcast applications and non-broadcast interactive-video uses.

Broadcast television applications are annually introduced to eager buyers at the SMPTE (Society of Motion Picture

(continued)

Stan Jarvis (POB 151044, Salt Lake City, UT 84115) *is president of* ISW Inc. *He holds a bachelor's degree in product development and an* M.B.A., *and he uses an* Otrona.

and Television Engineers) and NAB (National Association of Broadcasters) shows. These are the video equivalents of the annual National Computer Convention. An excellent recent example of state-of-the-art commercial equipment is the VSP (Video Sequence Processor) from Picture Element Ltd. PEL's new offering can accept video signals from any of the international standard video formats and process signals recorded in 525-line and 625-line interlaced rasters, or even proposed 1125-line formats. It outputs finished video signals in the selected formats. Further, it can process computer-developed images such as 512- by 512-pixel, or 1024- by 1024-pixel resolutions and output them to standard video. It can also record and play up to 8 minutes of video in real time, slow motion, or one frame at a time.

Another broadcast device of potential interest is the Cox CVP100 Computer Video Processor. This $13,000 device accepts a wide range of computer video formats, different scanning rates and logic pulses and outputs standard NTSC (National Television System Committee) video. Shintron has a similar product to interface home computers to NTSC video outputs.

In nonbroadcast applications, computer/video developments have been driven by the interactive requirements of video recorders and players used as a video signal source. A few years ago, small computer/video systems tended to be home built or one of a kind. Today, many companies market excellent products that feature integrated computer/video capabilities.

Interactive Training and Educational Systems

Instruction and training is a widely accepted application and a strong impetus for integrating computers and video equipment. Many early CAI (computer-aided instruction) projects failed to reach their expected potential because they lacked audio and realistic video images. Some educators and developers concluded that the addition of videodisc peripherals to CAI programs could improve the success rates of users. This has proven to be the case.

Training systems incorporating videodiscs are usually categorized in levels. Level 1 systems are the simplest, con-

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sisting of a video player and a monitor. The player may just as easily be a videocassette player, if the material is to proceed linearly with user intervention. Home videodisc players have internal microprocessors to handle drive housekeeping functions. All except the least-expensive players have sufficient power to accept commands for search, auto stop, chapter stop, and still-image display through either the player's keypad or via a CAT (computer-aided testing) plug. CAT is used to test machines under computer control at the end of the manufacturing process.

Table 1 lists four videodisc formats available today ranked in order of popularity. The majority of all videodisc drives are of the CED format (capacitance electronic disc), but only top-of-the-line players have ports and capabilities needed for computer connection. Currently, the LV (laser video) format is the easiest to work with because of the number of player brands and videodisc-pressing sources now available.

The VHD (video high-density) format is a technically neat compromise, able to play NTSC or PAL (Phase Alternate Line) from the same disc, but currently it is not available in the U.S. Panasonic's OMDR (optical memory disc recorder) allows you to record your own videodiscs. Blanks run several hundred dollars each. The not-yet-available (and unlisted) McDonnell-Douglas format will have a player, recorder, and duplicator, using a photographic film medium. Readily available Level 1 players include Pioneer-manufactured machines sold under the Pioneer, Sony, Magnavox, and Sylvania brand names.

Level 2 systems consist of a videodisc player and a controller, either internal or external. Control data can be decoded from a videodisc with a limited command set to handle most of the requirements. Level 2 systems are best limited to simple, dedicated applications, although this is a constantly changing area. For example, printers have been driven by Pioneer industrial players. The Sony player can drive a still-frame audio adapter.

Level 3 systems consist of a computer, videodisc player, video monitor, and any number of related peripherals. At a minimum, the computer controls the sequence of image strings from the videodisc player based on input from the user and control data stored on the videodisc, floppy disk, or other magnetic storage device.

Applications increasingly require computer-generated graphics to overlay a videodisc image. The earliest Level 3 systems, Apple or TRS-80-driven units using home-brew interfaces, demonstrated how difficult good-quality video overlay could be (see the text box "The Difficulty of Computer-Graphic/Video Overlay" on page 192).

Since that time, a number of video computer systems have shown significant improvement.

Terak is a specialized manufacturer whose equipment is often found in uni-

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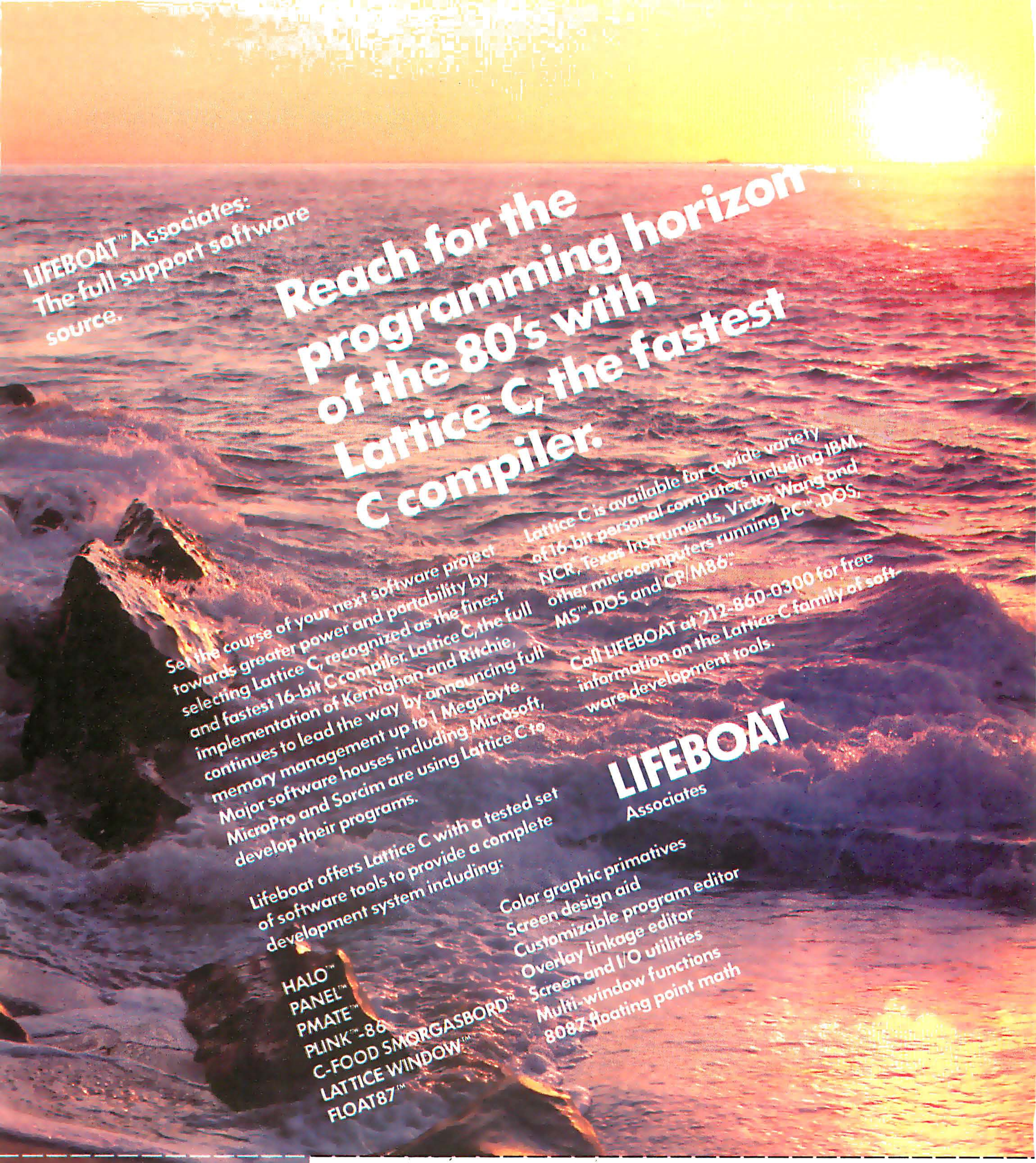
Table 1: *Videodisc formats available today.*

Type	Speed RPM	Capacity in minutes	NTSC images	Speed RPM	Capacity in minutes	PAL images	Technology pickup	Technology disc
CED	450	60	27,000	375	75	27,000	Capacitive	Grooved
LV	1,800	30	54,000	1,500	30	45,000	Optical	Reflective
VHD	900	60	54,000	750	60	45,000	Capacitive	Grooveless
OMDR	1,800	13	22,000				Optical	Recordable

Table 2: A *list of manufacturers and contact numbers for many of the products mentioned.*

Platter Pressers		
Laser Video	(714) 630-6700	Anaheim, CA
Pioneer	(201) 573-1122	New York, NY
Sony	(201) 930-6432	Park Ridge, NJ
Technidisc	(313) 352-5353	Troy, MI
3M	(612) 733-3906	St. Paul, MN
Players		
Hitachi	(312) 981-8989	Chicago, IL
Panasonic	(201) 348-7000	Secaucus, NJ
Philips	(212) 697-3600	New York, NY
Pioneer	(201) 573-1122	Montvale, NJ
Sony	(201) 930-6432	Park Ridge, NJ
VHD	(714) 660-9294	Irvine, CA
Videodisc Recorders		
Dover Instruments	(617) 366-1456	Westborough, MA
Optical Disc Corp.	(714) 522-2370	Cerritos, CA
Panasonic	(201) 348-7000	Secaucus, NJ
Hardware and Systems		
Bell & Howell	(312) 328-5175	Chicago, IL
Compuvision	(212) 532-9113	Santa Cruz, CA
Digital Controls	(404) 441-3332	Norcross, GA
DEC	(617) 276-4111	Bedford, MA
Digital Techniques	(617) 273-3495	Burlington, MA
Hazeltine	(703) 827-2300	McLean, VA
IEV	(801) 531-0757	Salt Lake City, UT
Micro Ed	(800) 642-7633	Eden Prairie, MN
NCR	(305) 323-9250	Lake Mary, FL
New Media Graphics	(617) 272-8844	Burlington, MA
Sony	(201) 930-6432	Park Ridge, NJ
Terak	(602) 998-4800	Scottsdale, AZ
Video Vision	(201) 377-0302	Madison, NJ
Visage	(617) 655-1503	Natick, MA

Information Sources and Conferences
Nebraska Videodisc Symposium, August 27-30, Lincoln, NE (402) 472-3611
Optical Memory News, POB 14817, San Francisco, CA 94114, (415) 621-6220
SALT 6th Annual Interactive Videodisc Conference, August 22-24, Washington, DC, (703) 347-0055
Videodisc Monitor, POB 26, Falls Church, VA 22046, (703) 241-1799



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PMATE and PLINK,TM Phoenix Software
FLOAT87,TM Microfloat
IBM and PC,®TM International Business Machines
MS,TM Microsoft
CP/M86,TM Digital Research

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versities and in industry. (Table 2 lists the phone numbers and addresses of companies mentioned in this article.) Terak offers a PDP 11-23-based processor, 512K bytes of RAM, and a 10-megabyte Winchester hard disk integrated with a videodisc player. The graphic system provides 256 simultaneous colors, 640- by 480-pixel resolution, and full video overlay. The Terak color computer costs less than $20,000.

The DEC IVIS (Interactive Video Information System) was announced last spring, based on Digital's top-of-the-line PRO-350 personal workstation. The IVIS includes most of the PRO-350 features such as a PDP 11-23 processor, up to 512K bytes of RAM, a 10-megabyte Winchester hard disk, and a VR241 RGB (red-green-blue) color monitor. The IVIS module attaches to the back of a PRO-350 chassis and accepts analog video signals from a Sony disc player. These signals are converted to RGB for display, with overlays capable of 960-pixel by 240-line resolution with up to eight simultaneous colors. Options include a mouse, joysticks, and a graphics pad. An IVIS system costs $18,600 with a membrane touch panel on the RGB monitor, and $16,600 without the panel.

Converting NTSC signals directly to RGB works well in the IVIS. The display is jitter-free and impressive. The RGB display approach is preferred by other manufacturers including Terak because overall resolution can be more easily optimized, eliminating the need to reconvert to NTSC. This is a case of adapting video to conform to the computer rather than adapting the computer to video. Early systems, such as TICCIT (Timesharing Interactive Computer Controlled Instructional Television—sponsored by the National Science Foundation) used standard analog television monitors, conforming the computer to the requirements of NTSC.

NCR (National Cash Register) introduced its first video/computer at the semiannual SALT (Society for Applied Learning Technology) conference on interactive systems. NCR has replaced the standard monochrome tube for an RGB color monitor in one of its personal office computers. Unlike the IVIS, the videodisc interface controller and RGB graphics-overlay boards are contained internally in the slots for expansion cards. The first model shown uses a Pioneer player and will retail for about $8000. A lower-priced IBM PC-compatible model, scheduled for a summer introduction, will receive the same video treatment. That model's price is targeted at $6500. This may indicate the start of a trend among office-computer manufacturers, where the video-enhanced models may be sold to a corporation as trainers for all the users of regular machines. Other companies are believed to be completing similar modifications, including Zenith. Some expect the forthcoming IBM "Vision Machine" to be a similar device.

Next year Sony should introduce its own videodisc recorder and a single box system with digital data decoding from the videodisc. Sony's VIPS (Visual Information Processing System) is based on the SMC-70 video-support microcomputer which controls its videodisc player(s), U-Matic, or Beta-format VCRs (videocassette recorders). The SMC-70 uses a 4-MHz Z80 with an optional 8086 Supercharger. Factory options include two types of graphic-image superimposers, still-frame audio, control of multiple players, touchscreen monitors, and a range of analog/RGB monitors. The VIPS has several graphic

(continued)

The Difficulty of Computer-Graphic/Video Overlay

To combine two NTSC signals to form a composite, both must be phase locked in the vertical, horizontal, and chroma, lest the image roll, flicker, or change color with time. Video sourced from videodiscs is usually more stable and accurate than that which comes from videotape, yet the signals still leave a great deal to be desired. There may be dropouts in the horizontal sync, vertical sync, or during the video. Some players turn off the video when they jump to relock on the start of the spiral at the end of each still frame.

Either the player can be locked to the overlay system or the system can be locked to the player. Sync locking often employs analog-phase looped systems to generate internal horizontal and vertical sync pulses. Locking the player and system to the vertical and horizontal syncs is relatively straightforward compared to locking to the chroma for two reasons.

First, as the size of single pixels on an overlay may be close to the same size as the chroma subcarrier, it is essential that a pixel clock not drift in relation to chroma lest its position or color change. For example, a single video line may contain about 256 color pixels. Out of some 50 usable microseconds per video line, each pixel's width would be about 200 nanoseconds, or a pixel frequency near 5 MHz. The 3.579545-MHz chroma subcarrier frequency has a period of 279 nanoseconds, close to the pixel frequency.

Second, NTSC specifies that the phase of the chroma signal will rotate 180 degrees every line and every black-and-white field (horizontal scanning frequency is 2/455th burst frequency or 227.5 cycles/line). With an odd number of lines (525) in every frame, the chroma will be out of phase 180 degrees with the chroma at the rising edge of the subsequent video frame. Because in every frame the phase rotates as well, it takes four fields for the chroma pulse to come back to zero-phase relationship. This presents little trouble when overlaying video-motion segments, or, for that matter, still-frame images from VHD or CED capacitance discs. (They record still-frame images as four and eight fields, respectively.) However, it is a problem when overlaying still frames from 1800 rpm videodiscs where a single two-field image is repeated continuously, so that chroma is out of phase 180 degrees every other frame. This problem can be resolved under master-computer control so that the overlay knows whether the disc is doing a still-frame or video-motion segment.

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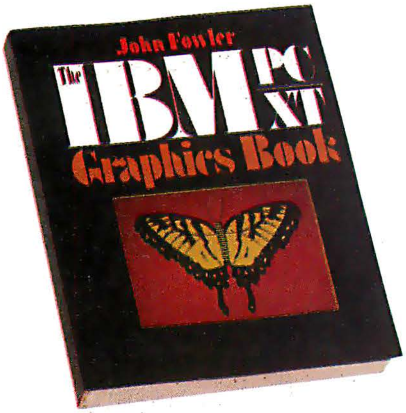
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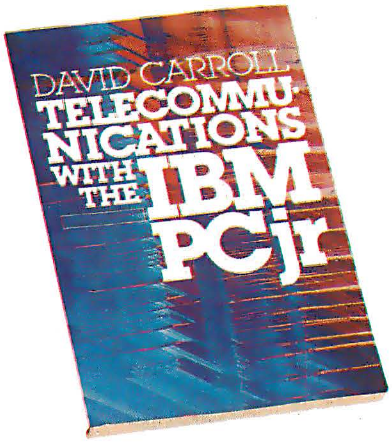
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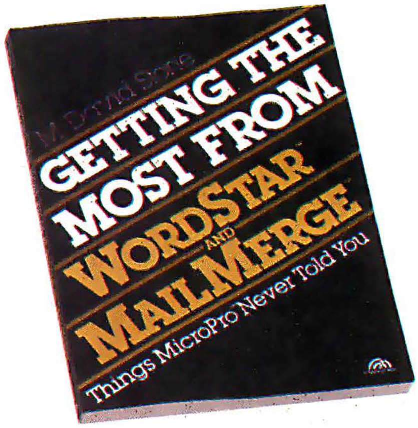
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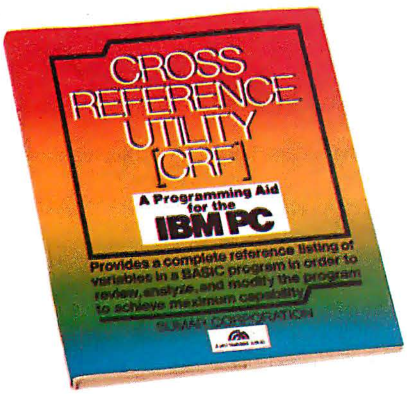
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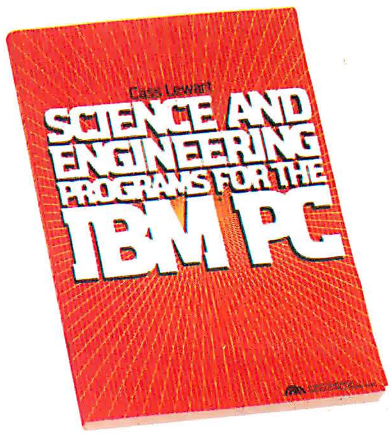
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modes including a 400- by 240-pixel, eight-color overlay onto video. Costs for single systems run $4000 to $8000, depending on options.

Japan Victor, the leading developer of the VHS (Video Home System) VCR format and the VHD videodisc format, sells an integrated system aimed at the home user. The system consists of a video microcomputer, an RGB graphic-overlay interface, a VHD videodisc player, and an analog/RGB monitor. (Analog/RGB monitors are being offered for home and business by most Japanese TV manufacturers.) The company's HC-6 personal computer runs MSX Microsoft BASIC with a Z80 processor and 32K bytes of RAM. Program data is sourced from either audiocassettes or ROM (read-only memory) cartridges. Options include a printer, modem, joysticks, and other peripherals. The HC-6 provides a 16-color text and graphic overlay at a resolution of 256 by 192 pixels, with up to 32 sprite planes. The visual performance is impressive, especially considering its retail price is well under $2000.

Similar MSX systems are offered by other VHD-format manufacturers in Japan, and by Sony for use with Beta VCRs. I especially like Sharp's inclusion of television channel and audio controls in the keyboard unit of its X-7 model. Even though the manufacturers project dramatic price reductions for these integrated home-video computers next year, it's unlikely that MSX systems will be introduced in the U.S. because none of the companies that manufacture them have strong home computer marketing channels.

COMPONENTS AND INTERFACES

In addition to integrated solutions offered by major manufacturers, boards are available that allow you to hook up videodisc players to almost any computer. These boards enable you to overlay computer signals over video as well. Over a dozen companies sell boards to connect Pioneer home videodisc players to Apple IIs. A similar number offer IBM boards. Here's a representative sample.

Starting again at the high end, New Media Graphics' $9850 GraphOver 9500 features a 768- by 480- by 4-bit display window, control, and switching for two video players, and both RGB and NTSC output. Software routines provide pan, step zoom, and split screens. A 6809 display processor is used, together with an NEC 7220 graphics generator. This device connects to any computer with an RS-232C interface.

Visage is releasing its first product for the IBM PC—the VDC-1000 videodisc controller card. The $1150 card features 15-color still and animated graphics with up to 32 sprites at a time. Four planes of overlays provide resolution of 190 by 256 pixels. The board also reads data

(continued)

that has been encoded on the videodisc. Visage is a well-financed start-up company with good field support.

IEV is another recent start-up, founded by engineering managers from a broadcast television character-generator company. IEV introduced a series of video boards for the IBM PC including a $400 video-overlay board. The board accepts NTSC composite video from tape or disc sources and RGB from one of two companion bit-mapped graphics boards. The baseboard provides a 16-color 640- by 400-pixel overlay for $750.

For some time, the lowest-price videodisc interface solution consisted of a year's subscription to BYTE and parts to duplicate Steve Ciarcia's Circuit Cellar interface, all for around $100. No commercially available interface is under the three-digit figure in the U.S., but some are coming close.

Micro-Ed has an interface connecting a Commodore 64 to Pioneer-manufactured consumer laser video players for $199. Video Vision Associates offers its VAI-135 interface to connect the same videodisc players to Apple II and IIe computers for $125. Neither offers video overlays. Coleco is rumored to have a videodisc interface for Adam in the works for home disc games.

Level 4 systems are at the esoteric end of interactive video. They are characterized by complexity, additional image post-processing, multichannel (up to 32) audio, windowing, digital-screen assembly, etc. Few are driven by single microcomputers. The cost of the videodisc hardware is rather insignificant to the overall price of Level 4 systems. Power and capabilities constantly change, so many features of developing Level 4 systems may be found in smaller systems in the near future.

Commercial and Point-of-Purchase Systems

Whereas most of the training video/computer applications tend to be used in companies or organizations, commercial uses are finding a broader audience. One emerging application is the point-of-purchase (POP) information presentation in retail stores.

POP computers and peripherals are similar to Level 2 and 3 training systems. A menu is presented on screen or on

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Sony should introduce its own videodisc recorder next year, and a single-box system with digital-data decoding from the videodisc.

a printed graphic panel. Viewers punch in the required digit(s) causing the videodisc drive to branch to a motion segment. At its conclusion, either another menu is presented for your selection or the program defaults to the starting menu.

Such systems are satisfactory, but more interesting things are possible when you add computer control. By Video, a Nolan Bushnell start-up, is sampling a kiosk with a videodisc player, touchscreen monitor, keyboard, and credit-card reader. The objective is to use interactive-video catalogs for shopping that is not assisted by human operators. Digital Techniques has introduced its similar Touchcom II intelligent POP/information terminal with options including a videodisc player and credit-card reader. A number of others are about to emerge as well.

Another market niche that rapidly is being filled with offerings is POP in computer stores. Compuvision introduced a POP system at the last COMDEX trade show using an RCA interactive player driven by a Commodore 64 hidden within a stand-up cabinet. Compuvision charges advertisers, whose product information the video player holds, for customers' viewing time in computer stores where the Compuvision machines are located. With expected usage fees, the machines are essentially free to the retailer. The computer keeps track of how often each "commercial" is selected by a customer and periodically transmits this information via modem to substantiate advertiser charges. Being a subsidiary of Softsel, a major software distributor, is a big plus for Compuvision.

Digital Controls has another approach. This company, a manufacturer of countertop video-arcade games, has been producing integrated training systems with its own Apple interface cards for several years. Digital Controls essentially swapped out the coin mechanism from its 6809-based game machine, added a keypad, and is marketing it as the Learning Center. It creates videodisc training courses for popular software packages, as well as monthly POP demonstration videodiscs for a wide variety of products. Retailers can easily program out products not offered in their stores. Digital Controls claims retailers can pay for the Learning Center in under three months by selling time to train customers to use new software products.

Local Video Recording for Computer Systems

One appeal of the integrated video/computer system is the practicality of creating custom video material. This is simple with videocassette integrations, because videocassette recording equipment is widely available. Discs present more of a problem. One can make custom laser videodiscs at Sony, 3M, Pioneer, Technidisc, Laser Video, Hitachi, or Sonopress. Expect to pay a $2000 to $3000 master cost plus a per-disc price of $20 or more in low volume. In higher quantities you may pay less than $10 apiece. Most factories require all video material to be submitted on 1-inch videotape.

If you need more confidentiality or security in making discs, or if you need only one disc, there are a number of alternatives. The Panasonic OMDR format uses recordable, preformatted, 20-centimeter diameter, optical discs. Two disc formats are available: 15,000 tracks for the lower-end recorder/players, and 22,000 tracks for the newest machine that also records in motion with stereo audio. The 15,000-track machines record one frame at a time and have variable playback speeds up to 30 frames per second, but they offer no audio. Panasonic's new $3000 player is being introduced to accompany the recorder/players priced from $20,000 to $30,000.

Other Japanese companies are developing videodisc recorders that are compatible with existing laser videodisc players, but none will introduce products in the U.S. before 1985.

Optical Disc Corporation (ODC) has announced a recorder using its own proprietary, unformatted recordable media. Recorded discs can be played on existing laser videodisc players. The ODC recorder has a base price of about $160,000. ODC is a start-up founded by former associates of DiscoVision.

Dover Instruments sells its Mastermaker for roughly the same price. It can be configured for any format including compact discs. Dover has supplied similar equipment or air-bearing turntables to most of the optical-disc manufacturers in the world.

Note that all the above are for making single masters only. (You can make copies on the OMDR using a recorder and a player for direct transfers.) If you expect to buy a recorder and go into business making any kind of discs, be aware that there are no real sources to sell you duplication equipment. Technically, making masters is easy when compared to the complexity and cost of making copies.

Vertically recorded magnetic videodiscs may be offered at affordable prices before optical-videodisc recorders. One of my Japanese associates showed me a paper comparing the vertical-recording head design and performance of Sony, Matsushita, Sharp, and other videodisc recorders. All the manufacturers reported current data densities four times greater than current optical videodisc densities and claimed to be interested in standardization of recording format. Whether that means a useful floppy videodisc is imminent is speculative.

Interactive Video Computer Software

Video-enhanced computer systems need good software to take advantage of the user interaction and possible visual capabilities. As with hardware, there has been a noticeable improvement in educational, training, and exhibition software.

Authoring systems deal with the mechanical requirements of running courseware on computers. Author software deals with display creation, response acceptance, analysis of constructed response, and conditional branching. More sophisticated authoring systems deal with broader areas of

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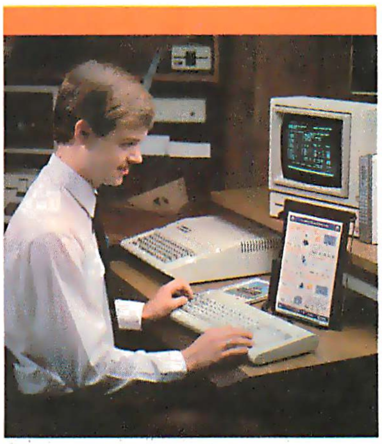


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critical concepts and variables, curriculum design, production, and revision. Authoring software can be categorized in levels on the basis of power and sophistication.

Authoring Level 0 includes software that simply controls the operation of the delivery hardware. Usually written in machine language or general-purpose language like BASIC or Pascal, this level is useful for single, unique applications where speed of delivery or size of produced code are the overriding factors.

Authoring Level 1 languages have commands and facilities expressly designed to support interactive video, but they require that you understand design philosophy and programming languages. Examples of Level 1 authoring systems include the powerful Tutor language used in Plato. Originally designed in the early 1970s for Control Data Corporation's CDC 6000-series mainframes, succeeding versions have been developed for a number of other computers. The Simpler system running on Modcomp equipment and DEC's recently announced DAL language for use on its VAX are direct descendants of the original Tutor language. Other examples include Coursewriter, used on the early IBM 1500 and now adapted for microcomputers and variations of the Pilot language that are used on home computers.

Authoring Level 2 provides a selection of elements or templates from which nonprogrammer authors can create lesson content. Some Level 2 authoring systems such as SMS support the structure of the courseware as well as the content. The earliest example of a Level 2 system was TICCIT, which merged video segments into instructional presentations. Other examples of the template approach are the Bell and Howell Pass system (for Apple II), Hazeltine's MicroTICCIT, and many others.

Authoring Level 3 is the most sophisticated type. Its metalanguage defines generic instructional elements that are grouped into sets of tools. It augments the instructional support available at Level 2 for nontechnical authors, where a specialist can design general instructional environments that are compatible with the hardware on which the produced courseware is to execute.

Most known authoring systems restrict users to a specific set of instructional components, yet it is not cer ain that these will be acceptable to the client or author who must use them. Level 3 systems provide a completely general facility so users can create their own instructional elements, if desired, to augment those supplied by the manufacturer.

An example of a Level 3 system is CDS (Courseware Design System). CDS, originally designed by Dr. James Schuyler in 1973-1975, provides a basic Level 1 language similar in many ways to Tutor, but additionally allows a lesson written in CDS to create or spawn another lesson. Electronic Information

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Table 3: *Videodisc players available in the U.S. that include computer interface capability.*

Brand and model	Unit price	Worst case access time	Computer port type	special features
Hitachi				
8500	$1200	6	RS-232C	
9500	$1600	3	RS-232C	external sync and subcarrier
Magnavox				
8010	$800	17	CAT plug	home model
Philips				
VP 832	$1400	5	RS-232C	250-frame instant jump
Pioneer				
LD 1100	$800	17	CAT plug	home, top loader
LD 700	$800	12	serial 8-pin DIN	home; front loader
LD V1000	$1200	3	parallel 24-pin	100-frame instant jump
LD V4000	$900	12	serial 8-pin DIN	industrial, front load
PR 8210	$950	17	CAT miniplug	low end industrial
LD V6000	$1600	3	RS-232C	built-in microcomputer
Sony				
LDP 1000A	$2500	3	RS-232C	ext. sync and subcarrier
Lasermax	$800	12	serial	home front loader
Sylvania				
VP 7200	$800	17	CAT plug	home model
Panasonic				
TQ 2020	$18,900	0.5	RS-232C	still video recorder
TQ 2021	$18,900	0.5	RS-232C	high-resolution black and white recorder
TQ 2022	$24,900	0.5	RS-232C	videodisc recorder
TQ 2023	$34,900	0.5	RS-232C	records motion and stereo
TQ 2024	$2985	0.5	RS-232C	player only

Systems Inc. currently develops microcomputer versions of CDS. CDS is unique in that courseware written on one manufacturer's hardware may also be delivered on other equipment as well. Sony recently announced CDS for its VIPS. IBM, Zenith, Terak, and Macintosh versions are expected soon.

Conclusion

The interface between computer and video systems has come a long way over the last few years. There is a positive trend toward greater product commitment from traditional corporations, and better-quality products from well-financed new companies. (Table 3 lists videodisc players available in the U.S. that have computer-interface capability.) In this article I've tried to present a sample range of the developments in this area.

Upcoming developments will include improved performance or less-expensive versions of currently available products. This indicates an expanding market in the future. Further ahead are new areas of technological developments such as vertical-magnetic recording. Some labs are working on solid-state, nonrotating videodiscs (not that farfetched when you consider that the marks on current videodiscs are about the size of the smallest elements in current silicon chips).

Another hotbed of development is multilayer optics used to bend and reflect X rays. Because X rays have shorter wavelengths than visible light, some envision vastly more compact memory devices, including videodiscs. Yet if any of these technological developments reach fruition by the end of the decade, their impact probably will be invisible to the user. The one near-term area of development that could be appreciated by users is the advent of high-resolution video hardware such as *1125-line HDTV* (high-definition television). Users who have wanted more RAM in their computers can relate to those who want more resolution in their video.

There has yet to emerge a product that might have the same dynamic effect on the videodisc market that VisiCalc had on the microcomputer market. Yet it is fair to conclude that the quality and range of today's video/computer offerings can satisfy most of today's applications. ■

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SN7407N	14	.29
SN7408N	14	.25
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SN7473N	14	.35
SN7474N	14	.35
SN7475N	16	.45
SN7476N	16	.35
SN7479N	14	4.95
SN7480N	14	.89
SN7482N	14	1.49
SN7483N	16	.59
SN7485N	16	.59
SN7486N	14	.35
SN7489N	16	2.25
SN7490N	14	.39
SN7491N	14	.79
SN7492N	14	.39
SN7493N	14	.39
SN7494N	14	.89
SN7495N	14	.49
SN7496N	16	.49
SN7497N	16	3.25
SN74100N	24	1.95
SN74104N	14	1.19
SN74105N	14	1.19
SN74107N	14	.29
SN74109N	16	.39
SN74116N	24	1.49
SN74121N	14	.39
SN74122N	14	.69
SN74123N	16	.49
SN74125N	14	.45
SN74126N	14	.45
SN74132N	14	.49
SN74136N	14	.69
SN74141N	16	.89
SN74142N	16	3.95
SN74143N	24	3.95
SN74144N	24	3.95
SN74145N	16	.59
SN74147N	16	1.49
SN74148N	16	1.19
SN74150N	24	1.19
SN74151N	16	.59
SN74152N	14	.59
SN74153N	16	.59
SN74154N	24	1.25
SN74155N	16	.59
SN74156N	16	.59
SN74157N	16	.59
SN74160N	16	.69
SN74161N	16	.69
SN74162N	16	.69
SN74163N	16	.69
SN74164N	14	.69
SN74165N	16	.69
SN74166N	16	.89
SN74167N	16	2.95
SN74170N	16	1.29
SN74172N	24	4.95
SN74173N	16	.69
SN74174N	16	.69
SN74175N	16	.69
SN74176N	14	.69
SN74177N	14	.69
SN74179N	16	1.49
SN74180N	14	.69
SN74181N	24	1.95
SN74182N	16	1.19
SN74184N	16	2.49
SN74185N	16	2.49
SN74190N	16	.69
SN74191N	16	.69
SN74192N	16	.69
SN74193N	16	.69
SN74194N	16	.69
SN74195N	16	.69
SN74196N	14	.89
SN74197N	14	.89
SN74198N	24	1.19
SN74199N	24	1.19
SN74221N	16	1.19
SN74251N	16	.79
SN74276N	20	2.49
SN74279N	16	.79
SN74283N	16	1.49
SN74284N	16	2.95
SN74285N	16	2.95
SN74365N	16	.55
SN74366N	16	.55
SN74367N	16	.55
SN74368N	16	.55
SN74390N	16	1.49
SN74393N	14	1.49

74LS

Part No.	**Pins	Price
74LS00	14	.25
74LS01	14	.25
74LS02	14	.29
74LS03	14	.25
74LS04	14	.29
74LS05	14	.29
74LS08	14	.29
74LS09	14	.29
74LS10	14	.29
74LS11	14	.35
74LS12	14	.35
74LS13	14	.39
74LS14	14	.59
74LS15	14	.35
74LS20	14	.29
74LS21	14	.29
74LS22	14	.29
74LS26	14	.29
74LS27	14	.29
74LS28	14	.35
74LS30	14	.29
74LS32	14	.39
74LS33	14	.55
74LS37	14	.35
74LS38	14	.35
74LS40	14	.29
74LS42	16	.55
74LS47	16	.75
74LS48	16	.75
74LS49	14	.75
74LS51	14	.25
74LS54	14	.25
74LS55	14	.29
74LS73	14	.39
74LS74	14	.49
74LS75	16	.39
74LS76	16	.39
74LS78	14	.39
74LS83	16	.65
74LS85	16	.89
74LS86	14	.39
74LS90	14	.55
74LS92	14	.55
74LS93	14	.55
74LS95	14	.79
74LS96	16	.89
74LS107	14	.39
74LS109	16	.39
74LS112	16	.39
74LS113	14	.39
74LS114	14	.39
74LS122	14	.49
74LS123	16	.79
74LS125	14	.49
74LS126	14	.49
74LS132	14	.59
74LS133	16	.59
74LS136	14	.39
74LS138	16	.89
74LS139	16	.79
74LS151	16	.59
74LS153	16	.59
74LS154	24	1.29
74LS155	16	.69
74LS156	16	.69
74LS157	16	.69
74LS158	16	.69
74LS160	16	.69
74LS161	16	.69
74LS162	16	.69
74LS163	16	.69
74LS164	14	.69
74LS165	16	1.19
74LS166	16	1.19
74LS169	16	1.19
74LS170	16	1.49
74LS173	16	.69
74LS174	16	.69
74LS175	16	.69
74LS181	24	2.95
74LS190	16	.89
74LS191	16	.89
74LS192	16	.79
74LS193	16	.79
74LS194	16	.69
74LS195	16	.69
74LS197	14	.79
74LS221	16	.89
74LS240	20	1.09
74LS241	20	1.09
74LS242	14	1.09
74LS243	14	1.09
74LS244	20	1.49
74LS245	20	1.49
74LS247	16	1.09
74LS248	16	1.09
74LS249	16	1.09
74LS251	16	.59
74LS253	16	.59
74LS257	16	.59
74LS258	16	.59
74LS260	14	.59
74LS266	14	.59
74LS273	20	1.49
74LS279	16	.49
74LS283	16	.69
74LS290	14	.89
74LS293	14	.79
74LS298	16	.89
74LS352	16	1.29
74LS353	16	1.29
74LS365	16	.49
74LS366	16	.49
74LS367	16	.49
74LS368	16	.49
74LS373	20	1.49
74LS374	20	1.49
74LS375	16	.69
74LS386	14	.45
74LS393	14	1.19
74LS399	16	1.49
74LS670	16	1.49
81LS95	20	1.49
81LS97	20	1.49

74S/PROMS*

Part No.	**Pins	Price
74S00	14	.35
74S02	14	.35
74S03	14	.35
74S04	14	.45
74S05	14	.45
74S08	14	.39
74S09	14	.39
74S10	14	.35
74S11	14	.35
74S15	14	.35
74S20	14	.35
74S22	14	.35
74S30	14	.35
74S32	14	.45
74S38	14	.89
74S40	14	.39
74S51	14	.35
74S64	14	.39
74S65	14	.39
74S74	14	.55
74S85	16	2.49
74S86	14	.55
74S112	16	.55
74S113	14	.55
74S114	14	.55
74S133	16	.45
74S134	16	.50
74S135	16	.69
74S136	14	1.39
74S138	16	.89
74S139	16	.89
74S140	14	.55
74S151	16	.99
74S153	16	.99
74S157	16	.99
74S158	16	.99
74S160	16	2.49
74S174	16	1.19
74S175	16	1.19
74S188*	16	1.49
74S194	16	1.49
74S195	16	1.49
74S196	14	1.49
74S240	20	2.25
74S241	20	2.25
74S242	14	2.49
74S243	14	2.49
74S244	20	2.49
74S251	16	1.19
74S253	16	1.19
74S257	16	1.19
74S258	16	1.19
74S260	14	1.19
74S280	14	1.95
74S287*	16	1.95
74S288*	16	1.95
74S373	20	2.49
74S374	20	2.49
74S387*	16	1.95
74S471*	20	5.95
74S472*	20	4.95
74S473*	20	4.95
74S474*	24	4.95
74S475*	24	4.95
74S570*	16	2.95
74S571*	16	2.95
74S572*	18	4.95
74S573*	18	4.95
74S940	20	2.49
74S941	20	2.49

CA—LINEAR

Part No.	**Pins	Price
CA3010H		1.35
CA3039H		1.35
CA3046N	14	1.35
CA3059N	14	2.95
CA3060N	16	2.95
CA3065E	14	1.49
CA3080E	8	.89
CA3081N	16	.99
CA3082N	16	1.19
CA3083N	16	1.49
CA3086N	14	.69
CA3089N	16	1.69
CA3096N	16	1.49
CA3130E	8	.89
CA3140E	8	.79
CA3160H		1.95
CA3161E	16	2.95
CA3162E	16	6.95
CA3189E	16	1.59
CA3401N	14	.59

CD—CMOS

Part No.	**Pins	Price
CD4000	14	.29
CD4001	14	.29
CD4002	14	.29
CD4006	14	1.19
CD4007	14	.29
CD4009	16	.59
CD4010	16	.59
CD4011	14	.29
CD4012	14	.29
CD4013	14	.39
CD4014	16	1.19
CD4015	16	.39
CD4016	14	.49
CD4017	16	1.19
CD4018	16	.99
CD4019	16	.59
CD4020	16	1.19
CD4021	16	1.19
CD4022	16	1.19
CD4023	14	.29
CD4024	14	.69
CD4025	14	.23
CD4026	16	2.49
CD4027	16	.45
CD4028	16	.69
CD4029	16	1.29
CD4030	14	.39
CD4034	24	2.49
CD4035	16	1.49
CD4040	16	1.19
CD4041	14	1.19
CD4042	16	.89
CD4043	16	.79
CD4044	16	.79
CD4046	16	1.19
CD4047	14	1.29
CD4048	16	.59
CD4049	16	.39
CD4050	16	.39
CD4051	16	.99
CD4052	16	.99
CD4053	16	.99
CD4056	16	2.95
CD4059	24	7.95
CD4060	16	1.49
CD4066	14	.59
CD4068	14	.39
CD4069	14	.29
CD4070	14	.39
CD4071	14	.29
CD4072	14	.29
CD4073	14	.29
CD4075	14	.29
CD4076	16	1.19
CD4078	14	.49
CD4081	14	.29
CD4082	14	.29
CD4093	14	.49
CD4098	16	1.95
CD4506	16	1.19
CD4507	14	1.19
CD4508	24	3.95
CD4510	16	1.29
CD4511	16	1.19
CD4512	16	1.19
CD4514	24	2.49
CD4515	24	2.49
CD4516	16	1.19
CD4518	16	1.19
CD4519	16	.59
CD4520	16	1.19
CD4526	16	1.49
CD4528	16	1.49
CD4529	16	1.69
CD4543	16	1.95
CD4562	14	6.95
CD4566	16	1.39
CD4583	16	2.49
CD4584	14	.69
CD4723	16	1.19
CD4724	16	1.19
MC14409	16	13.95
MC14410	16	13.95
MC14411	24	11.95
MC14412	16	13.95
MC14419	16	7.95
MC14433	24	13.95
MC14538	16	1.19
MC14541	14	1.19

(More In Catalog)

MICROPROCESSOR COMPONENTS

MICROPROCESSOR CHIPS

Part No.	**Pins	Function	Price
CDP1802	40	CPU	$2.95
2650	40	MPU (2 MHz)	9.95
MCS6502	40	MPU w/Clock	5.95
MCS6502B	40	MPU w/Clock at 3MHz	9.95
6809	40	CPU—8-bit (Internal Clock) 1MHz	14.95
6809E	40	CPU—8-bit (External Clock) 1MHz	14.95
INS8035N-6	40	MPU—8-bit (6MHz)	5.95
INS8039N	40	CPU-Sgl. chip 8-bit (128 bts. Ram)	5.95
INS8040N-6	40	CPU (256 bytes RAM)	9.95
INS8070N	40	CPU (64 bytes RAM)	29.95
INS8073N	40	CPU w/Basic Micro Interpreter	29.95
P8085A	40	CPU	4.95
8086	40	CPU 16-bit 5MHz	24.95
8088	40	CPU 8/16-bit	29.95
8155	40	HMOS RAM I/O Port-Timer	6.95
8748	40	HMOS EPROM MPU	24.95

Z80, Z80A, Z80B, Z8000 SERIES

Part No.	**Pins	Function	Price
Z80	40	CPU (MK3880N)(780C) 2MHz	$3.95
Z80-CTC	28	Counter Timer Circuit	3.95
Z80-DART	40	Dual Asynchronous Rec./Trans.	10.95
Z80-DMA	40	Direct Memory Access Circuit	9.95
Z80-PIO	40	Parallel I/O Interface Controller	3.95
Z80-SIO/0	40	Serial I/O (TxCB and RxCB Bonded)	12.95
Z80-SIO/1	40	Serial I/O (Lacks DTRB)	12.95
Z80-SIO/2	40	Serial I/O (Lacks SYNCB)	12.95
Z80-SIO/9	40	Serial I/O	12.95
Z80A	40	CPU (MK3880N-4)(780C-1) 4MHz	4.49
Z80A-CTC	28	Counter Timer Circuit	4.95
Z80A-DART	40	Dual Asynchronous Rec./Trans.	9.95
Z80A-DMA	40	Direct Memory Access Circuit	12.95
Z80A-PIO	40	Parallel I/O Interface Controller	3.95
Z80A-SIO/0	40	Serial I/O (TxCB and RxCB bonded)	12.95
Z80A-SIO/1	40	Serial I/O (Lacks DTRB)	12.95
Z80A-SIO/2	40	Serial I/O (Lacks SYNCB)	12.95
Z80A-SIO/9	40	Serial I/O	12.95
Z80B	40	CPU (MK3880N-6) 6MHz	9.95
Z80B-CTC	28	Counter Timer Circuit	12.95
Z80B-DART	40	Dual Asynch. Receiver/Transmitter	19.95
Z80B-PIO	40	Parallel I/O Interface Controller	12.95
Z8001	48	CPU Segmented	44.95
Z8002	40	CPU Non-Segmented	34.95
Z8030	40	Serial Comm. Controller	44.95
Z8036	40	Counter/Timer & Parallel I/O Unit	29.95

6500/6800/68000 SERIES

Part No.	**Pins	Function	Price
MC6502A	40	MPU with clock and RAM (2MHz)	6.95
MC6520	40	Peripheral Inter. Adapter	4.95
MC6800	40	MPU	2.95
MC6802CP	40	MPU with clock and RAM	7.95
MC6809E	40	CPU (1MHz) External (Locking)	14.95
MC6821	40	Peripheral Inter. Adapt (MC6820)	2.95
MC6828	24	Priority Interrupt Controller	15.95
MC6830L8	24	1024x8-bit ROM (MC68A30-8)	9.95
MC6850	24	Asynchronous Comm. Adapter	3.95
MC6852	24	Synchronous Serial Data Adapter	5.75
MC6860	24	0-600bps Digital MODEM	7.95
MC68000L8	64	MPU 16-Bit (8MHz)	49.95
MC68488P	40	General Purpose Int. Adapter	9.95
MC68652P2	40	Multi. Protocol Comm. Controller	24.95
MC68661PB	28	Enhanced Prog. Comm. Int.	9.95
MCM68764	24	64K EPROM (450ns)	24.95
SY6522	40	Peripheral Inter. Adapter	7.95

8080A SERIES

Part No.	**Pins	Function	Price
TMS5501	40	Synchronous Data Interface (SIRC)	14.95
INS8080A	40	CPU	2.95
INS8154	40	128 Byte RAM 16-Bit I/O	13.95
8156	40	RAM with I/O Port and Timer	6.95
INS82C06	20	Octal D FlipFlop Tri-State (74C374)	2.49
DP8212	24	8-bit Input/Output (74S412)	2.25
DP8214	24	Priority Interrupt Control	2.95
DP8216	16	Bi-Directional Bus Driver	1.95
DP8224	16	Clock Generator/Driver	2.25
DP8226	16	Bus Driver	2.25
DP8228	28	System Cont./Bus Driver (74S428)	3.49
DP8238	28	System Controller (74S438)	4.49
INS8243	24	I/O Expander for 48 Series	3.95
INS8245	18	16-Key Keyboard Encoder (74C922)	4.49
INS8246	20	20-Key Keyboard Encoder (74C923)	4.95
INS8247	28	Display Controller (74C911)	6.95
INS8248	28	Display Controller (74C912)	8.95
INS8250N	40	Asyn. Comm. Element	10.95
DP8251	28	Prog. Comm. I/O (USART)	4.49
DP8253	24	Prog. Interval Timer	6.95
DP8255	40	Prog. Peripheral I/O (PPI)	4.49
DP8257	40	Prog. DMA Control	5.95
DP8259	28	Prog. Interrupt Control	6.95
DP8275	40	Prog. CRT Controller	29.95
DP8279	40	Prog. Keyboard/Display Interface	8.95
DP8303	20	8-Bit Tri-State Bi-Directional Trans.	3.95
DP8304	20	8-bit Bi-Directional Receiver	2.95
DP8307	20	8-bit Bi-Directional Receiver	2.95
DP8308	20	8-bit Bi-Directional Receiver	2.95
DP8310	20	Octal Latched Peripheral Driver	4.95
8741	40	8-bit Univ. Peripheral Interface	29.95
8755	40	16K EPROM with I/O	24.95

DISK CONTROLLERS

Part No.	**Pins	Function	Price
INS1771-1	40	Single Density	16.95
FD1791	40	Single/Dual Density (Inv.)	29.95
FD1793	40	Single/Double Density (True)	29.95
FD1795	40	Dual Density/Side Select (Inv.)	29.95
FD1797	40	Dual Density/Side Select True	29.95

SPECIAL FUNCTION

Part No.	**Pins	Function	Price
DS0025CN	8	Dual MOS Clock Driver (5MZ)	2.49
DS0026CN	8	Dual MOS Clock Driver (5MZ)	1.95
INS2651	28	Communication Chip	8.95
MC3470P	18	Floppy Disk Read Amp System	4.95
MM58167AN	24	Microprocessor Real Time Clock	8.95
MM58174AN	16	Micro. Compatible Time Clock	7.95
COP402N	40	Microcontroller w/64-digit RAM and Direct LED Drive	5.95
COP402MN	40	Microprocessor w/64-digit RAM & Direct LED Drive w/N Buss Int.	5.95
COP470N	20	32-seg VAC Fluor. Drvr. (20-pin pkg.)	3.25
MM5369AA/N	8	Prog. Oscillator/Divider (60Hz)	1.79
MM5369EST	8	Prog. Oscillator/Divider (100Hz)	1.95

DYNAMIC RAMS

Part No.	**Pins			Price
1103	18	1024x1	(300ns)	.99
4027	16	4096x1	(250ns)	2.49
4116N-2	16	16,384x1	(150ns)	1.89 - 8/14.95
4116N-3	16	16,384x1	(200ns)	1.69 - 8/12.95
4116N-4	16	16,384x1	(250ns)	1.49 - 8/10.95
4164N-150	16	65,536x1	(150ns)	6.95 - 8/49.95
4164N-200	16	65,536x1	(200ns)	5.95 - 8/44.95
MM5261	18	1024x1	(300ns)	.49 - 8/1.95
MM5262	22	2048x1	(365ns)	.10
MM5270	18	4096x1	(250ns) MK4096	4.95
MM5280	22	4096x1	(200ns) 2107	3.95
MM5290-2	16	16,384x1	(150ns)	1.89 - 8/14.95
MM5290-3	16	16,384x1	(200ns)	1.69 - 8/12.95
MM5290-4	16	16,384x1	(250ns)	1.49 - 8/10.95
MM5298-3	16	8192x1	(200ns)	1.69

STATIC RAMS

Part No.	**Pins			Price
1101	16	256x1	(650ns)	1.49
2101	22	256x4	(450ns) 8101	2.49
2102	16	1024x1	(350ns)	.89
21L02	16	1024x1	(450ns) L.P.	1.49
2111	18	256x4	(450ns) 8111	2.95
2112	16	256x4	(450ns) MOS	1.95
2114	18	1024x4	(450ns)	1.49 - 8/9.95
2114L	18	1024x4	(450ns) L.P.	1.95 - 8/13.95
2114-2	18	1024x4	(200ns)	1.75 - 8/11.95
2114L-2	18	1024x4	(200ns) L.P.	2.25 - 8/14.95
2147	18	4096x1	(70ns)	4.95
2148	18	1024x4	(70ns)	4.95
TMS4045	18	1024x4	(450ns)	3.95
TMS40L47-45	20	1024x4	(450ns)	2.95
5101	22	256x4	(450ns) CMOS	2.95
MM5257	18	4096x1	(450ns) 4044	4.95
HM6116P-3	24	2048x8	(150ns) CMOS	5.95
HM6116P-4	24	2048x8	(200ns) CMOS	4.95
HM6116LP-4	24	2048x8	(200ns) L.P. CMOS	5.49
HM6264P-15	28	8192x8	(150ns) CMOS	39.95
27LS00	16	256x1	(80ns) L.P.	9.95
7489	16	16x4	(50ns) 3101	2.25
74C920	22	256x4	(250ns)	3.95
74C921	18	256x4	(250ns) CMOS	3.95
74C929	16	1024x1	(250ns) CMOS (6501)	3.95
74C930	18	1024x1	(250ns) CMOS (6518)	3.95
74S189	16	16x4	(35ns) 93405	1.95
74S200	16	256x1	(80ns) 93410	3.95
74S206	16	256x1	(60ns) 93411	3.95
74S289	16	16x4	(35ns) 3101	2.25
82S10	16	1024x1	(50ns) O.C. (93415)	3.95
82S25	16	16x4	(50ns) O.C. (74S289)	2.25

PROMS/EPROMS

Part No.	**Pins			Price
1702A	24	256x8	(1us)	4.95
2708	24	1024x8	(450ns)	3.95
2708-5	24	1024x8	(550ns) SM00246	2.95
TMS2516	24	2048x8	(450ns) 2716	5.95
TMS2532	24	4096x8	(450ns) NMC2532	6.95
TMS2564	28	8192x8	(450ns)	14.95
TMS2716	24	2048x8	(450ns) 3 voltage	9.95
2716	24	2048x8	(450ns)	4.95
2716-1	24	2048x8	(350ns)	5.95
2716D-5	24	2048x8	(550ns)	4.49
2732	24	4096x8	(450ns)	6.95
2732A-3	24	4096x8	(300ns)	7.95
2732A-4	24	4096x8	(450ns) 21V	6.95
2732D-4	24	4096x8	(550ns)	5.95
2758D-A	24	1024x8	(450ns)	2.95
2764-4	28	8192x8	(450ns)	9.95
2764-3	28	8192x8	(300ns)	14.95
MM52040	24	512x8 (1us)		4.95
MCM68764	24	8192x8	(450ns)	24.95
27128	28	16,384x8	(450ns) 128K EPROM	59.95
74S188	16	32x8	PROM O.C. (6330-1)	1.49
74S287	16	256x4	PROM T.S. (6301-1)	1.95
74S288	16	32x8	PROM T.S. (6331-1)	1.95
74S387	16	256x4	PROM O.C. (6300-1)	1.95
74S471	20	256x8	PROM T.S. (6309-1)	5.95
74S472	20	512x8	PROM T.S. (6349-1)	4.95
74S473	20	512x8	PROM O.C. (6348)	4.95
74S474	24	512x8	PROM T.S. (DM87S296N)	4.95
74S475	24	512x8	PROM O.C. (6340)	4.95
74S476	18	1024x4	PROM T.S.	6.95
74S478	24	1024x8	PROM T.S.	8.95
74S570	16	512x4	PROM O.C. (6305)	2.95
74S571	16	512x4	PROM T.S. (6306)	2.95
74S572	18	1024x4	PROM O.C. (6352)	4.95
74S573	18	1024x4	PROM T.S. (82S137)	4.95
82S23	16	32x8	PROM O.C. (27S18)	2.95
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82S123	16	32x8	PROM T.S. (27S19)	2.95
82S126	16	256x4	PROM O.C. (27S20)	2.95
82S129	16	256x4	PROM T.S. (27S21)	2.95
82S130	16	512x4	PROM O.C. (27S12)	3.95
82S185	18	2048x4	PROM T.S. (TBP24S81)	9.95
82S190	24	2048x8	(80ns)	14.95
82S191	24	2048x8	(80ns)	14.95
DM87S180N	24	1024x8	PROM O.C. (82S180)	9.95
DM87S181N	24	1024x8	PROM T.S. (82S181)	9.95
DM87S184N	18	2048x4	PROM O.C. (82S184)	9.95
DM87S185N	18	2048x4	PROM T.S. (82S185)	9.95
DM87S190N	24	2048x4	PROM O.C. (82S190)	14.95
DM87S191N	24	2048x8	PROM T.S. (82S191)	14.95

DATA ACQUISITION

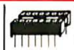
Part No.	**Pins	Function	Price
DC10		Mostek DC/DC Convert. +5V to -9V	2.95
MC3470P	18	Floppy Disk Read AMP System	4.95
MC1408L7	16	7-bit D/A Converter (DAC0807LCN)	1.49
MC1408L8	16	8-bit D/A Converter (DAC0808LCN)	2.25
ADC0803LCN	20	8-bit A/D Converter (±1/2LSB)	4.95
ADC0804	20	8-bit A/D Converter (1LSB)	3.49
DAC0806	16	8-bit D/A Converter (0.78% Lin.)	1.95
ADC0809	28	8-bit A/D Converter (8-Ch. Multi.)	4.49
ADC0817	40	8-bit A/D Converter (16-Ch. Multi.)	9.95
DAC1000	24	10-bit D/A Conv. Micro. Comp. (0.05%)	7.95
DAC1008	20	10-bit D/A Conv. Micro. Comp. (0.20%)	6.95
DAC1020	16	10-bit D/A Conv. (0.05% Lin.)	7.95
DAC1022	16	10-bit D/A Conv. (0.20% Lin.)	5.95
DAC1222	16	12-bit D/A Conv. (0.20% Lin.)	6.95
LM334Z		Constant Current Source	1.19
LM335Z		Temperature Transducer	1.40
LM399H		Temp. Comp. Prec. Ref. (.5ppm/C°)	5.00
AY-5-1013A	40	30K Baud Uart (TR1602)	3.95

LOW PROFILE (TIN) SOCKETS

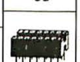
	1-9	10-99	100-up
8 pin LP	.16	.14	.13
14 pin LP	.17	.16	.14
16 pin LP	.19	.17	.16
18 pin LP	.26	.24	.23
20 pin LP	.30	.27	.25
22 pin LP	.31	.28	.26
24 pin LP	.33	.30	.28
28 pin LP	.40	.37	.35
36 pin LP	.46	.42	.39
40 pin LP	.49	.46	.43

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	1-9	10-99	100-up
8 pin SG	.30	.27	.25
14 pin SG	.43	.39	.37
16 pin SG	.47	.43	.41
18 pin SG	.53	.49	.47
24 pin SG	.69	.65	.61
28 pin SG	.81	.76	.72
36 pin SG	1.09	1.03	.97
40 pin SG	1.21	1.14	1.08


LP


SG


ST


WW

SOLDERTAIL STANDARD (TIN)

	1-9	10-99	100-up
14 pin ST	.29	.27	.25
16 pin ST	.34	.32	.30
18 pin ST	.38	.36	.34
20 pin ST	.45	.43	.41
24 pin ST	.49	.46	.43
28 pin ST	.69	.67	.63
40 pin ST	.99	.95	.89

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-9	10-99	100-up
8 pin WW	.49	.45	.42
10 pin WW	.65	.62	.59
14 pin WW	.65	.62	.59
16 pin WW	.69	.65	.61
18 pin WW	.89	.85	.79
20 pin WW	1.09	1.05	.99
22 pin WW	1.25	1.19	1.15
24 pin WW	1.29	1.23	1.18
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DT1050 — Applications: Teaching aids, appliances, clocks, automotive, telecommunications, language translations, etc.

The DT1050 is a standard DIGITALKER kit encoded with 137 separate and useful words, 2 tones, and 5 different silence durations. The words and tones have been assigned discrete addresses, making it possible to output single words or words concatenated into phrases or even sentences. The "voice" output of the DT1050 is a highly intelligible male voice. Female and children's voices can be synthesized. The vocabulary is chosen so that it is applicable to many products and markets.

The DT1050 consists of a Speech Processor Chip, MM54104 (40-pin) and two (2) Speech ROMs MM52164SSR1 and MM52164SSR2 (24-pin) along with a Master Word list and a recommended schematic diagram on the application sheet.

DT1050 Digitalker™ .... $34.95 ea.
MM54104 Processor Chip .... $14.95 ea.

DT1057 - Expands the DT1050 vocabulary from 137 to over 260 words. Includes 2 ROMs and specs.
Part No. DT1057 .... $24.95 ea.

INTERSIL

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Part No.	**Pins	Function	Price
7045IPI	28	CMOS Precision Timer	14.95
7045EV/Kit*	28	Stopwatch Chip, XTL	19.95
7106CPL	40	3½ Digit A/D (LCD Drive)	9.95
FE0203D		3½ Digit LCD Display for 7106 & 7116	19.95
7106EV/Kit*	40	IC, Circuit Board, Display	34.95
7107CPL	40	3½ Digit A/D (LED Drive)	11.95
7107EV/Kit*	40	IC, Circuit Board, Display	29.95
7116CPL	40	3½ Digit A/D LCD Dis. HLD	16.95
7201IUS		Low Battery Volt Indicator	2.25
7205IPG	24	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	24	Stopwatch Chip, XTL	14.95
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7206CEV/Kit*	16	Tone Generator Chip, XTL	7.95
7207AIPD	14	Oscillator Controller	5.95
7207AEV/Kit*	14	Freq. Counter Chip, XTL	7.95
7215IPG	24	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	24	4 Func. Stopwatch Chip, XTL	14.95
7216AIJI	28	8 Digit Univ. Counter C.A.	29.95
7216DIPI	28	8 Digit Freq. Counter C.C.	19.95
7217IJI	28	4 Digit LED Up/Down Counter C.A.	10.95
7217AIPI	28	4 Digit LED Up/Down Counter C.C.	11.95
7224IPL	40	LCD 4½ Digit Up Counter DRI	10.95
7226AEV/Kit*	40	5 Function Counter Chip, XTL	74.95

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NEW PRODUCT! 74HC High Speed CMOS

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74HC03	14	.75
74HC04	14	.59
74HCU04	14	.65
74HC08	14	.59
74HC10	14	.59
74HC11	14	.59
74HC14	14	.85
74HC20	14	.59
74HC27	14	.59
74HC30	14	.89
74HC32	14	.75
74HC42	16	.99
74HC51	14	.75
74HC58	14	.75
74HC73	14	.79
74HC74	14	.79
74HC75	16	.89
74HC76	16	.79
74HC85	16	1.59
74HC86	14	.69
74HC107	14	.59
74HC109	16	.79
74HC112	16	.79
74HC113	14	.79
74HC132	14	.99
74HC137	16	1.95
74HC138	16	1.09
74HC139	16	.99
74HC147	16	1.19
74HC151	16	.89
74HC153	16	.99
74HC154	24	2.49
74HC157	16	.89
74HC158	16	.89
74HC160	16	1.29
74HC161	16	1.29
74HC162	16	1.29
74HC163	16	1.29
74HC164	14	1.29
74HC165	16	2.79
74HC173	16	1.69
74HC174	16	.99
74HC175	16	.99
74HC192	16	1.39
74HC193	16	1.39
74HC194	16	1.09
74HC195	16	1.09
74HC237	16	2.95
74HC240	20	1.95
74HC241	20	1.95
74HC242	14	1.95
74HC243	14	1.95
74HC244	20	1.95
74HC245	20	2.49
74HC251	16	.89
74HC253	16	.99
74HC257	16	.89
74HC259	16	1.49
74HC266	14	1.19
74HC273	20	2.89
74HC280	14	3.95
74HC299	20	4.95
74HC366	16	2.39
74HC367	16	2.39
74HC373	20	2.39
74HC374	20	2.39
74HC390	16	1.49
74HC393	14	1.49
74HC533	20	2.39
74HC534	20	2.39
74HC595	16	3.95
74HC688	20	3.19
74HC4002	14	.59
74HC4017	16	2.19
74HC4020	16	1.39
74HC4024	14	1.59
74HC4040	16	1.39
74HC4060	16	1.39
74HC4075	14	.59
74HC4078	14	.69
74HC4511	16	2.69
74HC4514	24	3.79
74HC4538	16	2.39
74HC4543	16	3.49

74HCU04 is unbuffered. All others are buffered.

74C—C/MOS

Part No.	Pins	Price
74C00	14	.35
74C02	14	.35
74C04	14	.29
74C08	14	.35
74C10	14	.35
74C14	14	.69
74C20	14	.35
74C30	14	.35
74C32	14	.39
74C42	16	1.39
74C48	16	1.95
74C73	14	.79
74C74	14	.69
74C85	16	1.95
74C86	14	.39
74C89	16	5.95
74C90	14	1.19
74C93	14	1.19
74C95	14	1.39
74C107	14	.89
74C151	16	2.49
74C154	24	3.49
74C157	16	2.25
74C160	16	1.19
74C161	16	1.19
74C162	16	1.19
74C163	16	1.19
74C164	14	1.49
74C173	16	1.19
74C174	16	1.19
74C175	16	1.19
74C192	16	1.49
74C193	16	1.69
74C195	16	1.39
74C221	16	1.95
74C240	20	1.95
74C244	20	1.95
74C373	20	2.49
74C374	20	2.49
74C901	14	.59
74C903	14	.59
74C906	14	.59
74C911	28	8.95
74C912	28	8.95
74C915	18	1.19
74C917	28	8.95
74C922	16	4.49
74C923	20	4.95
74C925	16	5.95
74C926	18	5.95
80C95	16	.69
80C97	16	.69

LINEAR

Part No.	Pins	Price
TL071CP	8	.79
TL072CP	8	1.39
TL074CN	14	1.95
TL081CP	8	.59
TL082CP	8	1.19
TL084CN	14	1.95
LM301CN	8	.35
LM302H		1.95
LM304H		1.95
LM305H		.99
LM307CN	8	.45
LM308CN	8	.69
LM309K		1.25
LM309H		1.95
LM310CN	8	1.75
LM311CN	8	.69
LM312H		2.49
LM317T		1.19
LM317K		3.95
LM318CN	8	1.35
LM319N	14	1.95
LM320K-5		1.35
LM320K-12		1.35
LM320K-15		1.35
LM320K-24		1.35
LM320T-5		.89
LM320T-12		.89
LM320T-15		.89
LM320T-24		.89
LM322N	14	1.65
LM323K		5.95
LM324N	14	.59
LM329DZ		.65
LM331N	8	3.95
LM334Z		1.19
LM335Z		1.40
LM336Z		1.19
LM337MP		1.15
LM337T		1.95
LM338K		6.95
LM339N	14	.69
LM340K-5		1.35
LM340K-12		1.35
LM340K-15		1.35
LM340K-24		1.35
LM340T-5		.79
LM340T-12		.79
LM340T-15		.79
LM340T-24		.79
LM341P-5		.75
LM341P-12		.75
LM341P-15		.75
LM342P-5		.69
LM342P-12		.69
LM342P-15		.69
LF347N	14	1.49
LM348N	14	.99
LM350K		4.95
LF351N	8	.60
LF353N	8	1.00
LF355N	8	1.10
LF356N	8	1.10
LM358N	8	.69
LM359N	14	1.79
LM370N	14	4.49
LM373N	14	3.95
LM377N	14	1.95
LM380CN	8	1.10
LM380N	14	.89
LM381N	14	1.79
LM382N	14	1.39
LM384N	14	1.79
LM366N-3	8	.89
LM387N	8	.89
LM389N	16	1.19
LM391N-80	16	1.19
LM392N	8	.69
LM398N	8	3.95
LM399H		5.00
TL494CN	16	3.95
TL496CP	8	1.19
NE531V	8	2.95
NE544N	14	2.95
NE550A	14	1.95
NE555V	8	.35
XR-L555	8	.59
LM556N	14	.69
NE564N	16	2.95
LM565N	14	1.19
LM566CN	8	1.49
LM567V	8	.99
NE570N	16	3.95
NE571N	16	2.95
LM703CN	8	1.19
LM709N	14	.49
LM710N	14	.69
LM711N	14	.79
LM723N	14	.55
LM733N	14	1.00
LM739N	14	1.95
LM741CN	8	.35
LM747N	14	.69
LM748N	8	.59
LM1310N	14	1.49
MC1330AI	8	1.95
MC1349	8	1.79
MC1350	8	1.49
MC1358	14	1.95
LM1456V	8	1.95
LM1458CN	8	.59
LM1488N	14	.89
LM1489N	14	.89
LM1496N	14	1.95
LH1605CK		9.95
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LM1871N	18	2.95
LM1872N	18	3.25
LM1877N-9	14	2.49
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XR2211	14	3.95
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LM2901N	14	.59
LM2902N	14	.89
LM2907N	14	2.49
LM3189N	16	1.59
LM3900N	14	.59
LM3905CN	8	1.19
LM3909N	8	.99
LM3914N	18	2.95
LM3915N	18	2.95
LM3916N	18	2.95
RC4136N	14	1.25
RC4151NB	8	1.95
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LM4250CN	8	1.29
LM4500A	16	1.95
NE5532	8	2.49
NE5534	8	1.69
ICL8038B	14	3.95
LM13080N	8	1.19
LM13600N	16	1.19
76477	28	3.95

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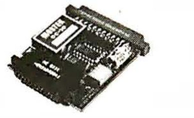
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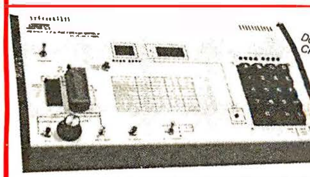
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JE664-A EPROM Programmer. $995.00
Assembled & Tested (Includes JM16A Module)

JE665 — RS232C INTERFACE OPTION — The RS232C Interface Option implements computer access to the JE664's RAM. This allows the computer to manipulate, store and transfer EPROM data to and from the JE664. A sample program listing is supplied in MBASIC for CP/M computers. Documentation is provided to adapt the software to other computers with an RS232 port. 9600 Baud, 8-bit word, odd parity and 2 stop bits.

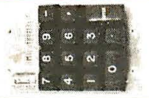
FOR A LIMITED TIME A SAMPLE OF SOFTWARE WRITTEN IN BASIC FOR THE TRS-80* MODEL I, LEVEL II COMPUTER WILL ALSO BE PROVIDED.

JE664-ARS EPROM Prog. w/JE665 Option. $1195.00
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EPROM JUMPER MODULES — The JE664's JUMPER MODULE (Personality Module) is a plug-in Module that pre-sets the JE664 for the proper programming pulses to the EPROM and configures the EPROM socket connections for that particular EPROM.

JE664 EPROM Jumper Mod. No.	EPROM	Programming Voltage	EPROM MANUFACTURER	PRICE
JM08A	2708	25V	AMD, Motorola, Nat., Intel, TI	$14.95
JM16A	2716, TMS2516 (TI)	25V	Intel, Motorola, Nat., NEC, TI, AMD, Hitachi, Mostek	$14.95
JM16B	TMS2716 (3-V's)	-5V, +5V, +12V	Motorola, TI	$14.95
JM32A	TMS2532	25V	Motorola, TI, Hitachi, OKI	$14.95
JM32B	2732	25V	AMD, Fujitsu, NEC, Hitachi, Intel, Mitsubishi, National	$14.95
JM32C	2732A	21V	Fujitsu, Intel	$14.95
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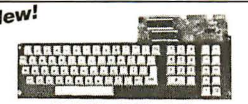
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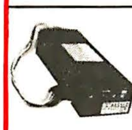
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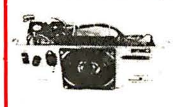
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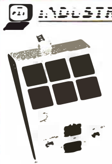
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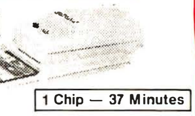
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CONTROLLING VIDEODISCS WITH MICROS

BY ROD DAYNES AND STEVE HOLDER

A *programming example in* BASIC *for the Sony* SMC-70

SUPPOSE YOU WANT to control a laser videodisc player with a personal computer, perhaps to create a game. And suppose you happen to have a constant angular velocity (CAV) version of an adventure movie (there are some good candidates available in this category). [Editor's Note: *In any instance in which you use a copyrighted videodisc you may have to obtain a license from the copyright owner.*] This article will give you a few pointers on what to look for and how to get started. In addition, a sample listing is included to demonstrate a few strategies for actually coding your creation.

Listing 1 is written for Sony's SMC-70 (system monitor controller) system, which includes Sony's Z80A-based computer with two 3.5-inch microfloppy disk drives, CP/M (R) operating system, an overlay (SMI-7073 RGB [red-green-blue] Superimposer), and an RGB/NTSC (National Television System Committee) monitor (PVM 1270Q), serially interfaced to the Sony LDP-1000A videodisc player. You can also use the LDP-1000, version 1.7 and newer versions.

The listing was written in Sony's Disk BASIC, which links a videodisc utility called "VX.PAC" (video extension package). VX.PAC includes all of the videodisc control commands designed specifically for the LDP-1000A disc player (an updated version of the utility just released also includes controls for Sony's still-frame audio unit and touchscreen). Sony also has a cache disk (disk emulator), which we did not have with our system.

VX.PAC has all of the commands you would expect for controlling a disc player. They include: LDPINIT, call videodisc intitialize; LDPOUT, call videodisc commands out; LDPDSEG, call videodisc define segment (a segment can be one frame long); LDPXSEG, call videodisc execute segment; LDPSSEG, call videodisc start playing segment; LDPSRCH, call videodisc search; LDPFRM, call videodisc frame; LDPSTART, call videodisc start; LDPWAIT, call videodisc wait; LDPEND, call videodisc end; LDPSTAT, call videodisc status; and LDPDISCID, call videodisc identification.

Commands for controlling the superimposer (overlay) include: INTSET, call interlace mode set; ASW, call audio switch; and VSW, call video switch.

You control the graphics display (which supports Sony's graphics package in the superimpose mode) by invoking: GLOAD, call graphic load; SLFONT, call select font; and TEXT, call text.

Particularly useful commands resident in the VX.PAC utility are: LDPEND, which holds the execution of a program until a particular video sequence has been completed; LDPFRM, a frame status request that can be used for timed waits; LDPSTAT, which reads all kinds of status from the LDP-1000 (or LDP-1000A) videodisc player; and LDPWAIT, which holds execution of the BASIC program until the disc frame number comes up.

A nice feature of the SMC-70 is that it is totally integrated with the LDP-1000A player, which is entirely capable of dealing with commands. You can

(continued)

Rod Daynes is vice president and principal of Interactive Technologies Corporation of San Diego, California. He is interested in videodisc-based games and simulations and is author of "The Videodisc Interfacing Primer," June 1982 BYTE, page 48.

Steve Holder is a programmer and author of two books, Elements of BASIC *and* Elements of COBOL.

Both authors may be contacted through ITC *at* 1131 G Street, San Diego, CA 92101.

tell the player to do something, e.g., play to the end of a sequence, and go on about your business. You do not have to keep your eye on it all the time.

Before You Begin

First of all, a CAV laser disc is required. Superior to constant linear velocity (CLV) laser discs for interactive video, CAV discs are frame addressable. Thus, they can use all the inherent functions of a laser disc, including fast frame accurate access, freeze frame, variable motion control, and frame step. In addition, they can handle data dumps from the second audio track, from the vertical interval, and from horizontally nested data. CLV discs, on the other hand, are not frame addressable, which eliminates the possibility for any meaningful external control.

However, CAV movie discs are harder to come by and more expensive. This is because CAV discs can only store about 30 minutes of linear footage per side. CLV discs can store roughly 60 minutes per side.

With CLV discs, less raw material is needed and movies can be pressed in less time, thus they are considered more economical by mastering facilities and distributors.

Until recently, CLV movie discs were a source of frustration for computer hobbyists and film buffs. Fortunately, several significant new releases are now available in both CLV and CAV formats, with more on the way.

Creating an interactive program from an existing movie can be almost impossible because some of the desired sequences are not on the disc. One development strategy is to let the program (game) grow naturally from the movie itself. After you decide on an objective (to "get the waiter to notice you," for example), take some time to separately catalog the desired edits, both the "ins" and the "outs". Next, determine which of these edits can be reassembled into entirely new scenes. Flowchart these segments so you can visualize all the various outcomes. After that you can write your program.

Be aware that the pacing and style of your program is just as important in an interactive mode as it is in a linear mode. Do not become a slave to the logic of your flowcharts. Long search times and short choppy sequences can be deadly. So become a film editor and try several alternatives before you commit yourself to a particular strategy. The operative word here is "orchestrate."

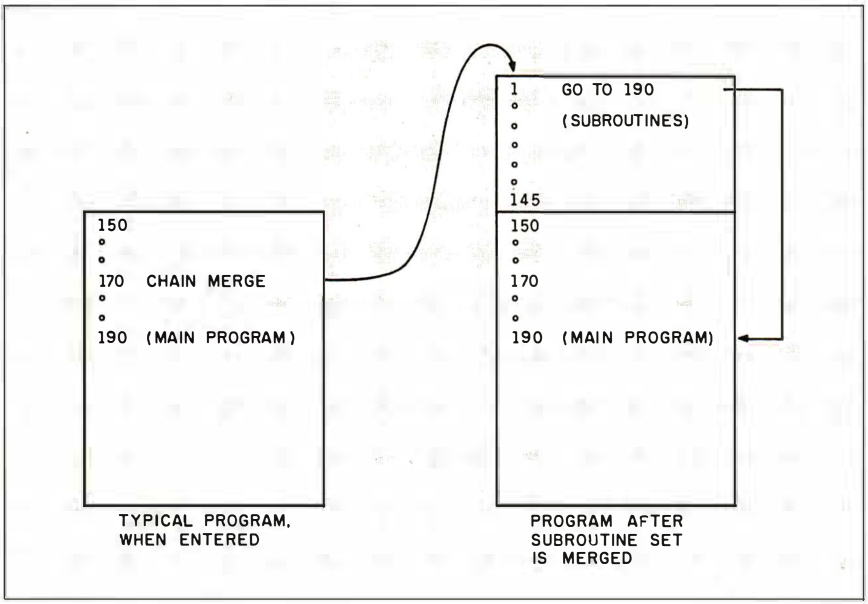


Figure 1: *Merging the subroutine set.*

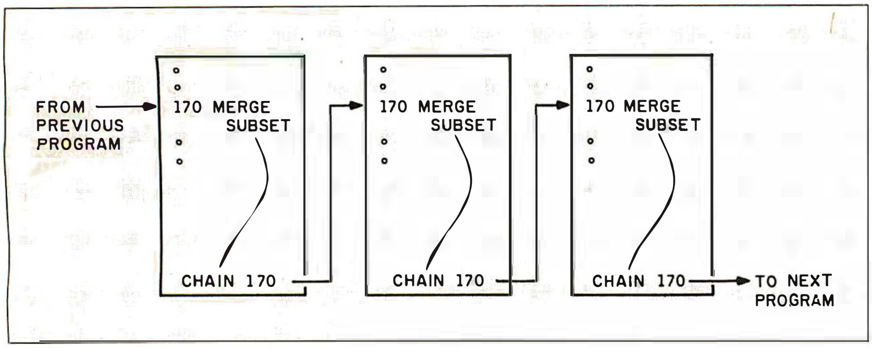


Figure 2: *Chaining the demonstration modules.*

The Demonstration Program

There are nine modules in the demonstration program (eight programs and one subset). This is due to restricted memory space. When one program has been completed successfully, the computer calls the next program via the CHAIN statement, passing variable values, such as the score. We structured the programs so that any one of them could be run separately. For example, you can begin the program in the middle if you implement the command RUN "TURN2." Or you can skip the title sequence and use RUN "FIRSTSEQ."

Since we divided the demonstration into separate programs, we faced the problem of writing the same set of subroutines in every program, with the exception of the TITLE program, which did not use any of the subroutines. To solve this redundancy/overhead problem, we wrote the subroutines as a separate file. This file is called "SUBSET." Each program merges the SUBSET file as needed. (Note: In order to be merged, SUBSET must be saved in ASCII format.) In other words, once you go through the title sequence the first time, lines 1–145 of the TITLE program are filed away and play no further part in the game. After the first run, if your hero meets with a grim demise, one of your choices is to pop into the SUBSET file that does all of the preliminary setup to take you through the first

(continued)

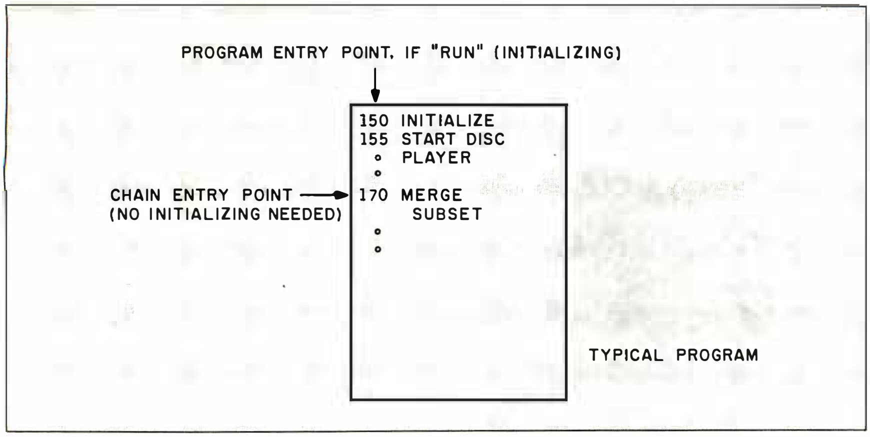


Figure 3: *Two program entry points.*

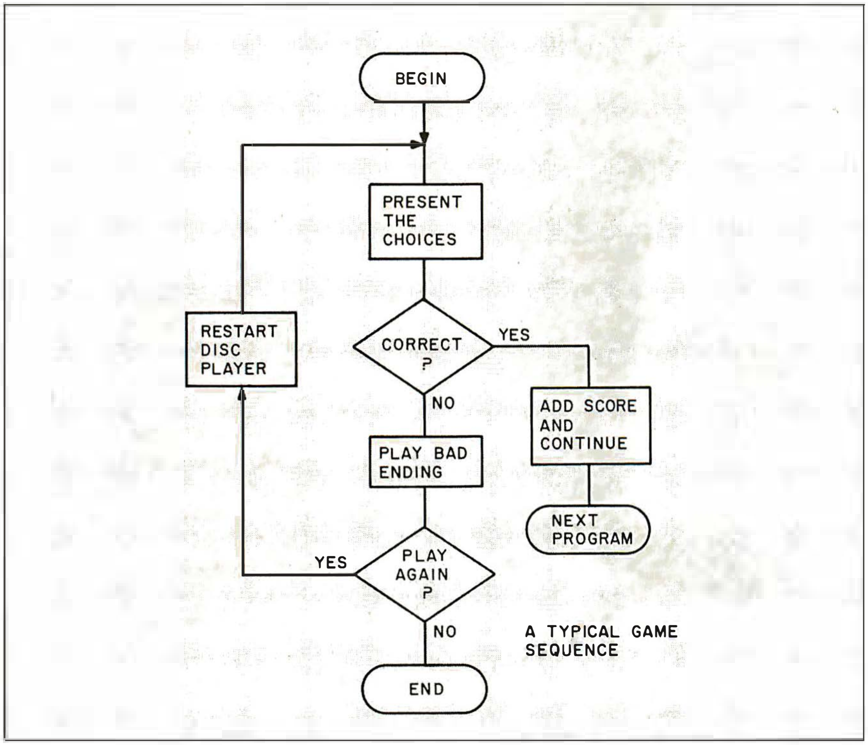


Figure 4: A *typical game sequence, the third program entry point.*

"play" sequence again.

The CHAIN/V/M statement (chain, variables, merge) merges the SUBSET file, preserving the value of all variables, then starts executing at the beginning of the newly merged program. The CHAIN/V/M statement is line 170 in every program other than TITLE. Since the same SUBSET file is merged into seven different programs, they had to be somewhat standardized. The lines in the SUBSET file are numbered 1–145, and every program is numbered from line 150 upward. In this way, no line-number conflict occurs when the two files are merged. The main body of every program begins at line 190, and the first instruction in the SUBSET file is GOTO 190, effectively continuing the program after the merge (see figure 1). Each program enters the next one at line 170, where the SUBSET file is merged with the newly called program (see figure 2).

Since each action sequence was written as a separate program, we had to allow for the possibility that one of them might be inadvertently run without the benefit of the original initialization. Therefore, the first lines of each program (lines 150–165) initialize arrays, screen, and disc player before the subset is merged. If the program is RUN instead of being merged, it will not crash (see figure 3).

Using scenes played from the videodisc, each program presents a problem (or two) that you must solve or overcome. If correct, you are rewarded with points and the game continues. If incorrect, play is interrupted with an appropriate "bad ending" scene played from the disc (whenever possible). You are then given the choice of quitting or trying again.

To preserve your score to this point, if you choose to try again, we chain the program back to itself. This presents the third entry point at line 155, reinitializing the disc player to repeat the scene (see figure 4).

To take advantage of the sound track (audio is defeated in the still and variable motion modes) and to maintain the feel of the original film, we let the motion run continuously wherever possible. This has the effect of luring you into the adventure. But you have to stay on your toes. Quick decisions, which can take you by surprise, are demanded at various points. You may be watching a sequence and suddenly there is a closeup of a waiter approaching and the chair being pulled back. You must make a choice: (1) drop your spoon, (2) use your fork, or (3) duck. The correct choice is to use your fork, which is acknowledged by a flashing score in the upper right corner as the disc continues to play. If you: (1) do not respond in time, or (2) choose the wrong option, the computer turns the NTSC video off and searches the disc for a short sequence with the sound of a sniff. Simultaneously, in the RGB mode, IGNORED is printed. After a short pause, the text is erased and another graphic appears while the disc searches for an appropriate reaction shot. The RGB is turned off, the NTSC is turned on, the motion sequence of the reaction shot is played, and at the completion of the motion sequence, an overlay is turned on that asks you if you would care to play again (see figure 5).

(continued)



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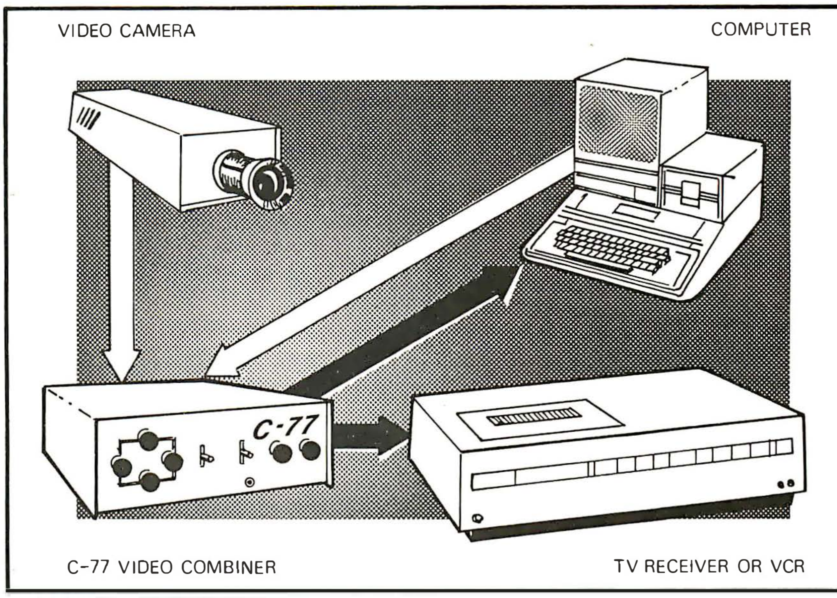
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Listing 1: *The following action sequences, with appropriately chosen sound effects, dialogue, and screen prompts, show the personal computer's great range as a videodisc game creator and controller. Program 1, the "subset" file, is automatically invoked whenever your hero meets with a bad end. It returns you to the main program, gives you your score, and asks you whether or not you want to continue.*

Program 1:

```
  1 _INTSET (1,0): GOTO 190: ' Enter main program after merging
  5 '
 10 '                         "SUBSET"
 15 '           Standard Routines Merged to Each Module
 20 EVAL INKEY$                                             'TIMED WAIT
 25 _LDPFRM (F#): A$= INKEY$                                'Subroutine
 30 IF A$= " " THEN IF F# < LIMIT GOTO 25                   '(Uses LIMIT)
 35 RETURN
 40 '
 45 CCOLOR 4,2: LOCATE(19,0): PRINT "YOUR SCORE:          " 'FLASHSCORE
 50 CCOLOR 4,2,2: LOCATE(31,0): PRINT SCORE:                'Subroutine
 55 CCOLOR 6,0,0: RETURN                                    '(Uses SCORE)
 60 '
 65 GCLEAR 8: SCORE = SCORE + POINTS                        'SCORE
 70 GOSUB 45: 'FLASHSCORE                                   'Subroutine
 75 FOR K% = 1 TO 4: BEEP: PAUSE 2: NEXT K%: PAUSE 30       '(Uses POINTS)
 80 CCOLOR 4,2: LOCATE(31,0): PRINT SCORE
 85 CCOLOR 6,0,0: RETURN
 90 '
 95 LOCATE (20 - LEN(MSG$)/2, 20)                           'BAD END
100 CCOLOR 6: PRINT MSG$                                    'Routine
105 LOCATE (12,22): PRINT "PLAY AGAIN? (Y/N)"               :(Uses MSG$,
110 GOSUB 45: EVAL INKEY$                                   ' PRGM$)
115 A$ = INKEY$: IF A$ = " " THEN 115              "
120 CCLEAR: IF A$= "Y" OR A$= "y" THEN CHAIN /V PRGM$,155 'Restart module,
125 _VSW(0): CONSOLE 80: GCLEAR 8: GCOLOR ,, 8: CCLEAR      'or reset screen.
130 DELETE 1-145: END                                       'Deleting enables main
                                                            module to be rerun.
135 '
140 _VSW(0): CONSOLE 80: GCLEAR 8: GCOLOR 8: CCLEAR         'ERROR
145 PRINT "ERROR "; ERR; " ON LINE "; ERL: GOTO 130         'Routine
```

Program 2:

```
  1 '
  5 ' Written in SONY SMC-70 Disk BASIC using VX.PAC utility commands.
 10 CONSOLE 40: CURSOR OFF : GCOLOR ,,4: GCLEAR 4           'Screen red.
 15 CCLEAR: _LDPINIT: _INTSET(1,0)                          'Set raster interlace
 20 _LDPOUT (&H51): _LDPSTART (1000,1001)                   'Start disc
 25 DIM FONT%(1600): _SLFONT(FONT%(0), "ROM70")             'Load overlay font.
 30 _VSW(2) : GCLEAR 8: GCOLOR 8,8,8: CCOLOR 0,1,0          'Set up screen.
 35 _LDPWAIT (1002)                                         'Wait for title.
 40 _TEXT(129,56,"THE",FONT%(0),0,0,1)                      'First in black,
 45 _TEXT(128,55,"THE",FONT%(0),7,7,1)                      'then overlay white
 50 _TEXT(123,146,"GAME",FONT%(0),0,0,1)                    'for drop shadow.
 55 _TEXT(122,145,"GAME",FONT%(0),7,7,1)
 60 _LDPWAIT(1003): GCLEAR: _LDPWAIT(1004)                  'Wait, erase, wait.
 70 LOCATE(4,16) :PRINT SPACE$(32) :LOCATE(4,17) :PRINT SPACE$(32)
 75 LOCATE(4,18) :PRINT "          DEVELOPED BY           "
 80 LOCATE(4,19) :PRINT SPACE$(32)                          'Mask and overlay.
 85 LOCATE(4,20) :PRINT "           ROD DAYNES            "
 90 LOCATE(4,21) :PRINT SPACE$(32) :LOCATE(4,22) :PRINT SPACE$(32)
 95 _TEXT(58,80,"NIGHT OF THE",FONT%(0),0,6,1,1)            'Superimposed.
100 _TEXT(76,100, "BIG DINNER",FONT%(0),0,6,1,1)
105 _LDPWAIT(1005)                                          'Wait original timing.
110 LOCATE(4,16) :PRINT SPACE$(32) :LOCATE(4,17) :PRINT SPACE$(32)
115 LOCATE(4,18) :PRINT "          PROGRAMMING BY         "
120 LOCATE(4,19) :PRINT SPACE$(32)
125 LOCATE(4,20) :PRINT "          STEVE HOLDER           "
130 LOCATE(4,21) :PRINT SPACE$(32) :LOCATE(4,22) :PRINT SPACE$(32)
```

(continued)

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```
135  __LDPWAIT(1006)                                                    'Wait next credit.
140  LOCATE(3,15) :PRINT SPACE$(34) :LOCATE(3,16) :PRINT SPACE$(34)
145  LOCATE(3,17) :PRINT SPACE$(34)                                     'Larger mask need here.
150  LOCATE(3,18) :PRINT "           PRODUCED BY                "
155  LOCATE(3,19) :PRINT SPACE$(34)
160  LOCATE(3,20) :PRINT "           INTERACTIVE TECHNOLOGIES       "
165  LOCATE(3,21) :PRINT SPACE$(34) :LOCATE(3,22) :PRINT SPACE$(34)
170  LOCATE(3,23) :PRINT SPACE$(34) :LOCATE(3,24) :PRINT SPACE$(34);
175  CCOLOR 7,0,0: __LDPWAIT(1007                                       'Get ready to clear.
180  GCLEAR: CCLEAR: CCOLOR 4,1                                         'Go.
185  FOR K%= 15 TO 22:LOCATE(3,K%) :PRINT SPACE$(34) :NEXT              ;Mask, then print
190  LOCATE(6,17): PRINT "THE OBJECT . . . . ."                         'first line.
195  __LDPWAIT(1008)                                                    'Wait for sound.
200  LOCATE(15,19) :PRINT "GET THE WAITER TO NOTICE YOU"                'Second line.
205  __LDPWAIT(1009)                                                    'Wait for scene change.
210  FOR K%= 16 TO 22:LOCATE(4,K%) :PRINT SPACE$(32): NEXT              'Smaller mask.
215  LOCATE(6,17) :PRINT "YOU ONLY HAVE ONE SHOT AT IT."
220  __LDPWAIT(1010)                                                    'Wait for music.
225  LOCATE(12,19) :PRINT "A WRONG DECISION . ."                        'Second line.
230  __LDPWAIT(1011)                                                    'Wait for music.
235  LOCATE(5,21) :PRINT "AND IT'S ALL OVER FOR YOU. PAL!"
240  __LDPWAIT(1012)                                                    'Wait scene change.
245  FOR K%= 16 TO 22:LOCATE(3,K%) :PRINT SPACE$(34):NEXT               'Remask.
250  LOCATE(5,17) :PRINT "YOU CAN EARN MUCH NEEDED POINTS"
255  __LDPWAIT(1013)                                                    'Wait scene change.
260  LOCATE(5,19) :PRINT "WITH YOUR POWERS OF OBSERVATION"
265  __LDPWAIT(1014): LOCATE(10,21)                                     'Wait for sound.
270  PRINT "AND QUICK REACTIONS."
275  __LDPWAIT(1015)                                                    'Wait for next credit.
280  __VSW(3): CCOLOR 6,0,0: CCLEAR                                     'We're done.
285  CHAIN /V "FIRSTSEQ", 170                                           'Warm entry. First
                                                                        Sequence.
```

Program 3:

```
150  DIM FONT%(1600): CONSOLE 40: CURSOR OFF                           'Cold start (if RUN).
155  GCOLOR ,,8: GCLEAR 8: CCOLOR 6,0,0: CCLEAR                        'Restart entry point
160  __LDPINIT: __LDPOUT (&H51): __INTSET(1,0)                          '(see line 120,
                                                                       "SUBSET")

165__LDPSTART (1016, 1017)
170  CHAIN /V/M "SUBSET"                                               'Warm start entry point
175                                                                    'After chain/merge,
180  '                "FIRSTSEQ"                                       'execution begins at
185  '                                                                 'first instruction,
190  __VSW(3): ON ERROR GOTO 140                                       '(line 1, "SUBSET"): a
195  __SLFONT(FONT%(0),"SSER70")                                       'jump to line 190.
200  __TEXT(0,135,"QUICK!", FONT%(0),6,6,1)                            'This prints off
205  __TEXT(5,150,"1 = DROP SPOON", FONT%(0),6,6,1)                    'screen. We wait
210  __TEXT(5,165,"2 = USE FORK", FONT%(0),6,6,1)                      'for the right
215  __TEXT(5,180,"3 = BELCH", FONT%(0),6,6,1)                         'moment, then . . .
220  __LDPWAIT(1018) :BEEP:__VSW(2)                                    'raise the curtain.
225  LIMIT = (1019): GOSUB 20: 'TIMED WAIT                             'Answer quick!
230  IF A$ = "2" THEN 285                                              'Right answer?
235  GCOLOR ,,1: GCLEAR 1                                              'Screen blue (masked).
240  __LDPSTART(1020,1021)                                             'Let's hear gunshot
245  __TEXT(105,80,"CLATTER", FONT%(0),4,5,10,4:                       'timed with graphic.
250  PAUSE 5:GCLEAR 1                                                  'Notes: screen is
255  __TEXT(70,120,"AARRRGGHH", FONT%(0),4,5,3,3)                      'masked when gcolor,
260  __LDPSTART(1022,1023)                                             'gclear not = 8.
265  PAUSE 1: GCLEAR 8: GCOLOR ,,8                                     'Pause for disc access.
270  MSG$ = "TOO BAD. YOU LOSE."                                       'He falls down.
275  PRGM$ = "FIRSTSEQ": GOTO 95                                       'BAD END
280  '
285  POINTS = 375: GOSUB 65                                            'Yes. You score.
290  CHAIN /V "TURN1", 170                                              'Warm entry, next
                                                                       module
```

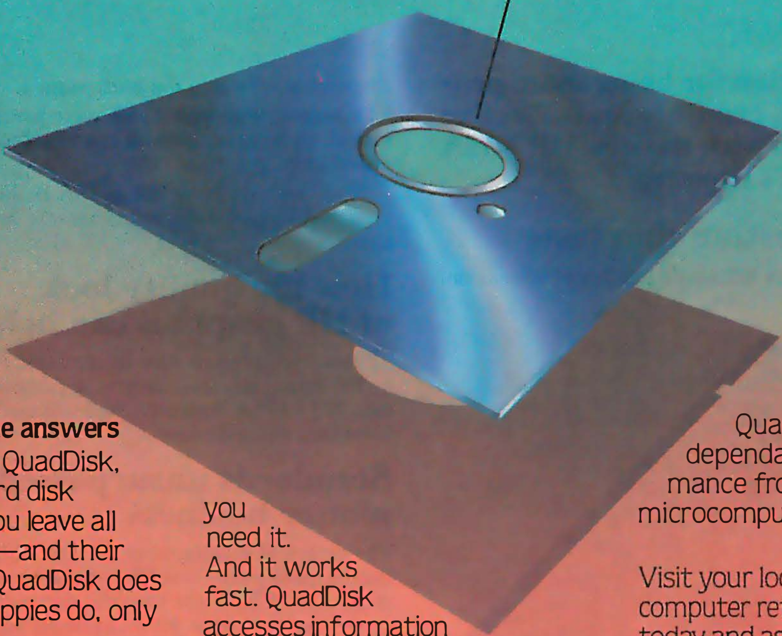
Program 4:

```
150  DIM FONT%(1600): CONSOLE 40: CURSOR OFF                           'Cold s art.
155  GCOLOR ,,8: GCLEAR 8: CCOLOR 6,0,0: CCLEAR                        'Restart entry point.
160  __LDPINIT: __LDPOUT (&H51): __INTSET(1,0)                          'Out byte turns off
165  __LDPSTART (1024, 1025)                                           'disc index display.
```

(continued)

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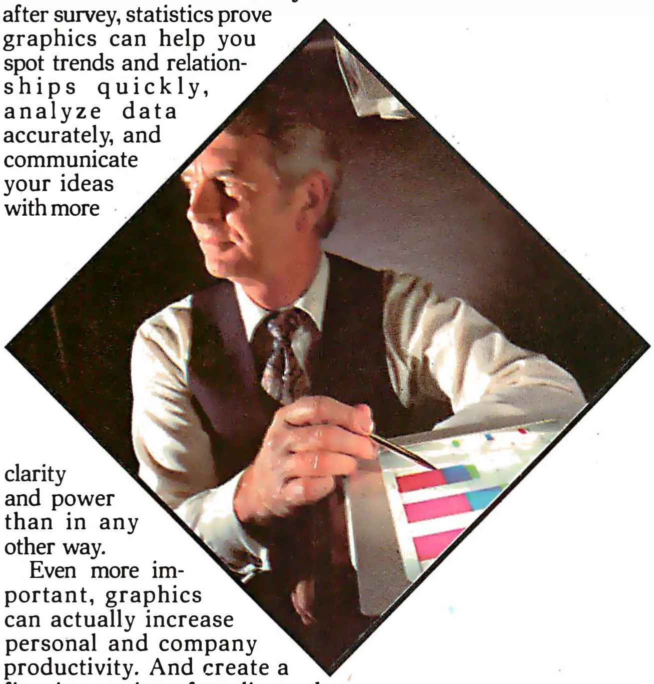
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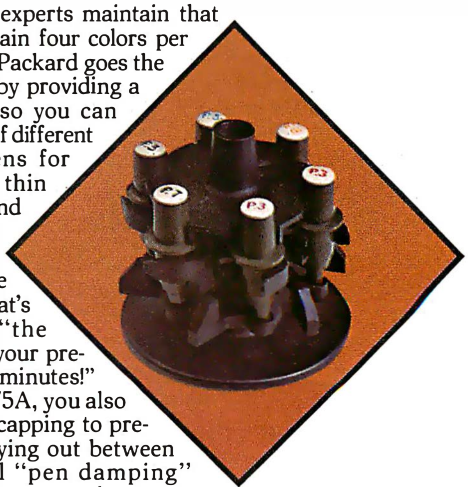
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```
170 CHAIN /V/M "SUBSET"                                  'Warm start entry point.
175 '
180 '                 "TURN1"                            '__ is abbrev. for 'call'.
185 '
190 __VSW(3): ON ERROR GOTO 140                          'VideoSWitch(3) = disc
195 __SLFONT(FONT%(0),"SSER70")                          'video only.
200 __TEXT(100,20,"1 = GO STRAIGHT", FONT%(0),6,6,1)     'Print off screen
205 __TEXT(5,180,"2 = TURN RIGHT",FONT%(0),6,6,1)        'and wait.
210 CCLEAR: __LDPWAIT(1026): __VSW(2): BEEP              'Overlay on.
215 LIMIT = 1027: GOSUB 20: 'TIMED WAIT                  'Choose fast.
220 IF A$= "2" THEN 265                                  'Choice correct?
225 GCOLOR ,,4:GCLEAR 4                                  'Screen red.
230 __LDPSTART (1028, 1029)                              'No. You lose.
235 GCLEAR 8: GCOLOR ,,8: __LDPWAIT(1030)                'Wait for effect.
240 LOCATE(2,19)
245 PRINT "YOUR WAITER REFUSES TO SEAT YOU."             'He's arrogant.
250 PAUSE 20: PRGM$ = "TURN1"                            'Pass this program's
                                                         name
255 MSG$= "NOW YOU MUST PAY A BRIBE": GOTO 95            'so it can be restarted.
260 '
265 GCLEAR 8: POINTS = 490: GOSUB 65                     'Yes. You score!
270 CHAIN /V "TURN2", 170                                'Warm entry, next
                                                         module
```

Program 5:

```
150 DIM FONT%(1600): CONSOLE 40: CURSOR OFF              'Cold start.
155 GCOLOR ,,8: GCLEAR 8: CCOLOR 6,0,0: CCLEAR           'Restart entry point.
160 __LDPINIT: __LDPOUT (&H51): __INTSET(1,0)
165 __LDPSTART (1037, 1032)
170 CHAIN /V/M "SUBSET"                                  'Warm start entry point.
175 '                                                    'SelectFONT reads file
180 '                 "TURN2"                            'of graphic data into
185 '                                                    '1600 element array.
190 __VSW(3): ON ERROR GOTO 140
195 __SLFONT(FONT%(0),"SSER70")
200 __TEXT(10,10,"1 = GO STRAIGHT",FONT%(0),6,6,1)       'Off screen.
205 __TEXT(10,180,"2 = TURN RIGHT", FONT%(0),6,6,1)
210 CCLEAR: __LPDWAIT(1033): __VSW(2): BEEP              'Overlay on.
215 LIMIT = 1034: GOSUB 20: 'TIMED WAIT                  'Answer quick!
220 IF A$= "1" THEN 255                                  'Right way?
225 GCOLOR ,,6: GCLEAR 6: __LDPSTART(1035,1036)          'Oops. Wrong way.
230 __TEXT(40,100,"DON'T STEP IN THE . . .",FONT%(0),4,4,1)
235 PAUSE 11: GCLEAR 8: GCOLOR ,,8                       'Pause for timing.
240 __TEXT(120,100,". . .GRAVY",FONT%(0),6,6,1)
245 MSG$= "DIDN'T MAKE IT!": PRGM$ = "TURN2"
250 GOTO 95                                              'BAD END
255 POINTS = 615: GOSUB 65: PAUSE 10: CCLEAR             'You score!
260 '                STICKY BUNS
265 __VSW(3): __TEXT(0,120,"HURRY!", FONT%(0),6,6,1)     'Next test.
270 __TEXT(0,135,"PICK ONE!", FONT%(0),6,6,1)
275 LOCATE(0,19): PRINT "1 = NAPKIN"                     'List of tools.
280 PRINT "2 = SHIRT": PRINT "3 = FINGER BOWL"
285 PRINT "4 = PANTS": PRINT "5 = HAIR"
290 __LDPWAIT(1037): __VSW(2): LIMIT = 1038: GOSUB 20     'TIMED WAIT
295 GCLEAR 8: CCLEAR: IF A$ = "3" THEN 350               'Right one?
300 __LDPWAIT(1039): __LDPOUT(&H4F): BEEP                'Freeze.
305 LOCATE(10,18): PRINT "OH NO! STICKY BUNS!!"          'No. Ouch!
310 PAUSE 30: PRINT : BEEP: BEEP
315 PRINT "WHEW! HE SURVIVES BUT HE DRAWS FLIES"
320 LOCATE(10,21): PRINT "YOU LOSE 290 POINTS."          'Lose points
325 PAUSE 30: POINTS = (-290): GOSUB 65                  'but game
330 PAUSE 20: CCLEAR: GCOLOR ,,1: GCLEAR 1               'continues.
335 __LDPSTART(1040,1041)
340 GCLEAR 8: GCOLOR ,,8: GOTO 375
345 '
350 LOCATE (2,22): CCOLOR 6: __LDPWAIT(1042)             'Right tool.
355 PRINT "THE NAPKIN MAKES STICKY BUNS HARMLESS."
360 POINTS = 960: GOSUB 65: PAUSE 20: CCLEAR
365 __LDPWAIT(1043)                                      'Wait next sequence.
370                    Simon says
375 'LOCATE(14,20): PRINT "PRESS ANY KEY"                'Instructions.
```

(continued)

```
380 LOCATE(9,21): PRINT "WHEN NAME SAYS 'STOP'."
385 LIMIT = 1044: GOSUB 20: __LDPOUT(&H4F): CCLEAR      'TIMED WAIT
390 IF F# > 1045 THEN 445:                               'Too slow.
395 IF F# < 1046 THEN 455:                               'Too fast.
400 SPD = INT((F# - 1047)/3)                             'Reaction speed = ?
405 ON SPD GOTO 415, 420, 425, 430                       'Select score.
410 A$ = "EXCELLENT": POINTS = 2440: GOTO 435            '(F# = frame #,
415 A$ = "GREAT": POINTS = 2170: GOTO 435                'from LDPFRM
420 A$ = "VERY GOOD": POINTS = 1950: GOTO 435            'command in TIMED
425 A$ = "GOOD": POINTS = 1640: GOTO 435                 'WAIT subroutine.)
430 A$ = "O.K.": POINTS = 100
435 LOCATE(2,20): PRINT A$; "REACTION. SCORE "; POINTS; " POINTS."
440 GOTO 465
445 LOCATE(6,22): PRINT "TOO SLOW!" YOU LOSE 200 POINTS."
450 POINTS = (-200): GOTO 465
455 LOCATE(6,22): PRINT "YOU OVER-REACTED. LOSE 200 POINTS!"
460 POINTS = (-500)
465 GOSUB 65: PAUSE 20: __LDPOUT(&H3A): CCLEAR           'Play forward.
470 __LDPWAIT(1048): __LDPOUT(&H4A): LOCATE(4,20)        'Wait, then freeze.
475 PRINT "POOR GUY. HE DIDN'T GET DESSERT!"
480 PAUSE 25: LOCATE(11,21): PRINT "YOU MAY NOT, EITHER!"
485 PAUSE 25: GCOLOR ,,1: GCLEAR 1
490 CHAIN /V "GRAVY", 170                                'Warm entry, next
                                                         module.
```

Program 6:

```
150 DIM FONT%(1600): CONSOLE 40: CURSOR OFF              'Cold start.
155 GCOLOR ,,1: GCLEAR 1: CCOLOR 6,0,0: CCLEAR           'Restart entry point.
160 __LDPINIT: __LDPOUT (&H51): __INTSET(1,0)
165 '
170 __LDPSRCH(1049) :CHAIN /V/M "SUBSET"                 'Warm start entry point.
175 '
180 '              "GRAVY"                                'VideoSWitch(2) = super-
185 '                                                     'imposer + computer
190 __VSW(2): ON ERROR GOTO 140: CCLEAR                  'screen overlayed on
195 __SLFONT(FONT%(0),"SSER70")                          'videodisc.
200 PAUSE 5: GCLEAR 8: GCOLOR ,,8: LOCATE(3,22)
205 PRINT "YOU'LL HAVE TO AVOID THIS GRAVY STAIN."       'Over still frame.
210 PAUSE 50: CCLEAR: GCOLOR ,,1: GCLEAR 1
215 __LPDSRCH(1050): PAUSE 5                             'Next still frame.
220 GCLEAR 8: CGOLOR ,,8: LOCATE(7,18)
225 PRINT "A LADLE STICKS OUT OF THE GRAVY."
230 PAUSE 25: LOCATE(12,19): PRINT "CAN YOU AVOID IT?"
235 PAUSE 35: IF SCORE > 2100 THEN 295                   'Minimum score to qualify.
240 '          Low score, little chance.
245 LOCATE(11,21): PRINT "YOU HAVE NO CHOICE."
250 LOCATE(2,22): PRINT "PRESS ANY KEY AND TAKE YOUR CHANCES."
255 CH = INT(SCORE/49 + .5): LOCATE(3,23)                'Chance = % of 4900 pts.
260 PRINT "(YOU HAVE A      OUT OF 100 CHANCE)";
265 LOCATE(15,23): PRINT CH;
270 EVAL INKEY$
275 A$ = INKEY$: IF A$ = " " THEN 275                    'Wait until ready.
280 RANDOMIZE: K = RND(Q): CCLEAR                        'Pick random #.
285 IF K ( SCORE/4900 THEN 565 ELSE 485                  'High score, good odds.
290 '          Trivia, anyone?
295 CCLEAR: LOCATE(0,16)
300 PRINT "      YOU'VE SCORED WELL SO FAR."
305 PRINT "THE MAITRE'D SMILES ON YOU AND WILL"
310 PRINT "GUARANTEE YOUR PASSAGE AROUND THE GRAVY, IF"
315 PRINT "YOU AGREE TO ANSWER A RANDOM QUESTION."
320 PRINT "IF NOT, YOU TAKE YOUR CHANCES."
325 PRINT "IF YOU AGREE AND ANSWER WRONG . . ."
330 PRINT "IT'S DEATH! YOU WANT THE QUESTION? (Y/N)"
335 EVAL INKEY$
340 A$ = INKEY$: IF A$ = " " THEN 340
345 IF A$ = "N" OR A$ = "n" THEN CCLEAR: GOTO 250         'Trust the odds?
350 IF A$ <> "Y" AND A$ <> "y" THEN 340                   'Yes or No only.
355 RANDOMIZE: Q = IRND(7)                               'Pick random question.
360 ON Q GOTO 375, 385, 395, 405, 415, 425, 435          'Go get Q & A.
365 Q$ = "NAME THE WAITER WHO SEATED YOU IN THE
    KITCHEN."                                            'Save memory; load only
```

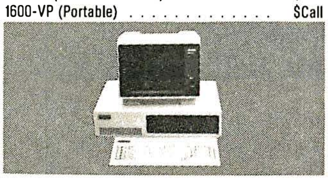
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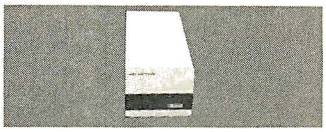
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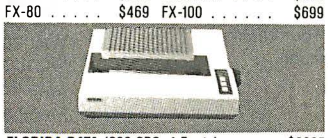
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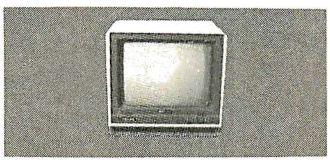
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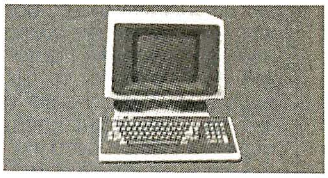


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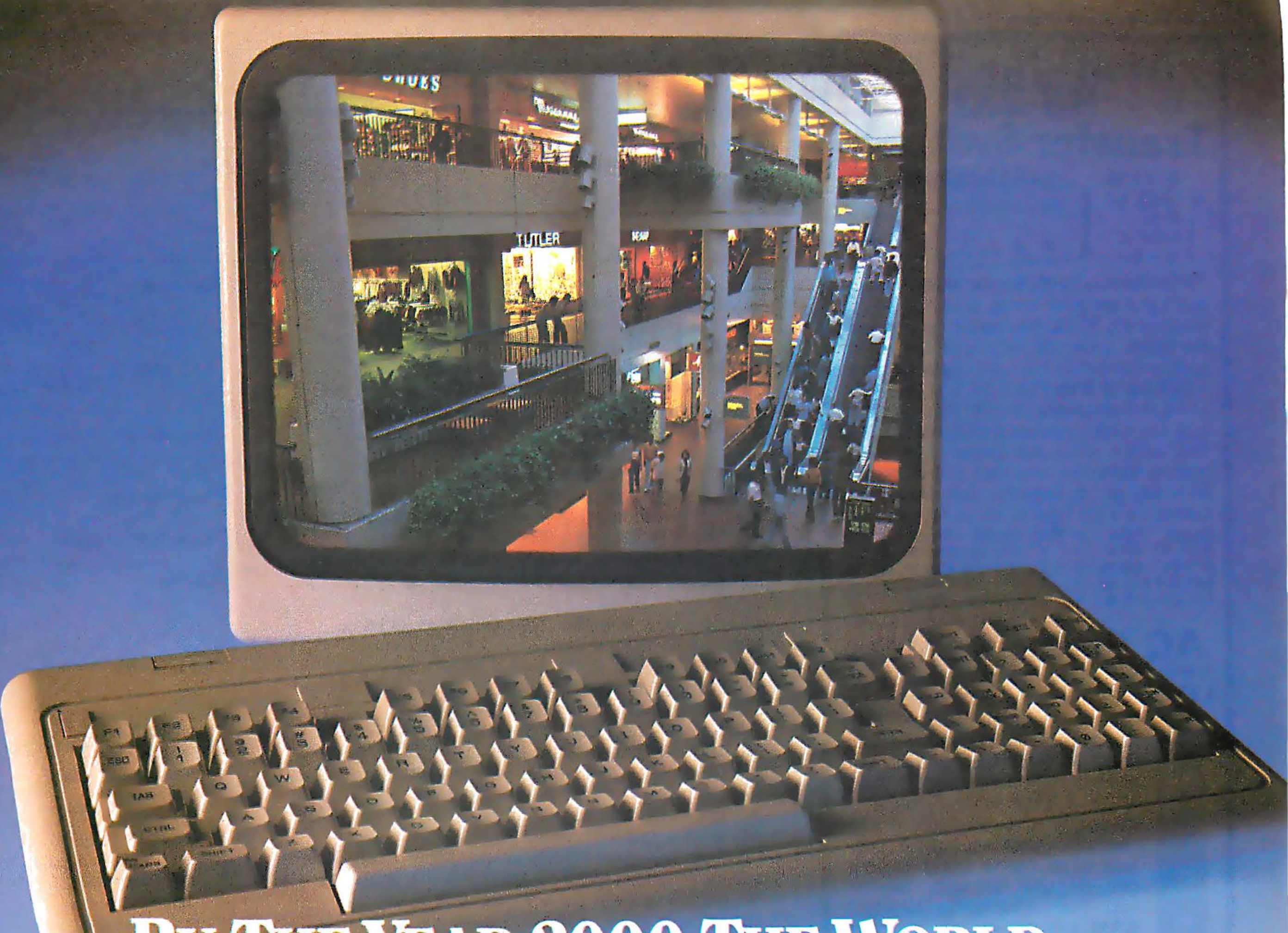
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370 A$ = "CARBUNCLE": GOTO 445                         'Q & A needed.
375 Q$ = "NAME THE WAITER WHO BROUGHT YOU OUT."
380 A$ = "INGEMAR": GOTO 445
385 Q$ = "WHO GOT TO THE TABLE FIRST?"
390 A$ = "MOOKY": GOTO 445
395 Q$ = "NAME THE KITCHEN DWELLERS."
400 A$ = "FRED": GOTO 445
405 Q$ = "STAND-UP COMIC?"
410 A$ = "RASPUTIN": GOTO 445
415 Q$ = "WHAT IS THE SOUND OF ONE HAND CLAPPING?"
420 A$ = "YES": GOTO 445
425 Q$ = "WHAT GOES WITH CORNED BEEF?"
430 A$ = "CABBAGE": GOTO 445
435 Q$ = "CAN YOU KISS THE OUTSIDE OF YOUR ELBOW?"
440 A$ = "NOT DURING DINNER": GOTO 445
445 CCLEAR: LOCATE(0,1): PRINT Q$                      'Print question.
450 PRINT "(UPPER CASE ONLY, PLEASE.)"
455 INPUT /L, RESP$: CCLEAR: Q$ = " "                  '(Release memory.)
460 _TEXT(40,80, "YOUR ANSWER IS. . .",FONT%(0),6,0,3,1): PAUSE 10
465 FOR K% = 1 TO LEN(RESP$)-LEN(A$) + 1               'Search resp for right ans.
470 IF MID$(RESP$,K%,LEN(A$))= A$ THEN A$ = "RIGHT": GOTO 565
475 NEXT K%: A$ = "WRONG"                              'Didn't find it.
480 '        Doesn't quite get around
485 GCLEAR 8: _LDPSTART(1051,1052)                     'Start him across.
490 _LDPWAIT(1053): _LDPOUT(&H3C): D = 1               'Slow motion.
495 FOR K% = 5 TO 1 STEP -1: PAUSE K% * 6              'Decaying loop.
500 _LDPOUT(&H44 + D * &H8)                            'Fwd or reverse
505 D = D * (-1): NEXT K%                              'depending on D's sign.
510 PAUSE 3: GCOLOR ,,4: GCLEAR 4: CCOLOR 6            'Screen turns red.
515 MSG$ = "AAAIIIYYYEEEEE": C% = 19 + IRND(2)
520 FOR L% = 1 TO 14
525 LOCATE(C%,L% + 5): PRINT MID$(MSG$,L%,1)           Print msg in random
530 C% = C% - 1 + IRND(2): PAUSE 1: NEXT L%            'pattern down screen.
535 _LDPSTART(1054,1055,1056)                          'Slow motion of
540 PAUSE 3: CCLEAR: GCLEAR 8: GCOLOR ,,8              'silverware falling.
545 IF A$ = "WRONG" THEN _TEXT(110,140,"WRONG!",FONT%(0),4,4,1)
550 PAUSE 20: MSG$ = "THAT'S IT FOR YOU, PAL!"
555 PRGM$ = "GRAVY": GCLEAR 8: GOTO 95                 'BAD END
560 '        Gets by
565 _LDPSTART(1057,1058)
570 GCLEAR 8: GCOLOR ,,8: _LDPWAIT(1059)               'Wait until he's around.
575 IF A $ = "RIGHT" THEN _TEXT(90,150,"CORRECT!",FONT%(0),4,4,1)
580 PAUSE 20: POINTS = SCORE: GOSUB 65                 'Double the score.
585 PAUSE 10: CHAIN /V "TURN3", 170                    'Next challenge.
```

Program 7:

```
150 DIM FONT%(1600): CONSOLE 40: CURSOR OFF            'Cold start.
155 GCOLOR ,,8: GCLEAR 8: CCOLOR 6,0,0: CCLEAR         'Restart entry point.
160 _LDPINIT: _LDPOUT (&H51): _INTSET(1,0)
165 _LDPSTART(1060,1061)
170 CHAIN /V/M "SUBSET"                                'Warm start entry point.
175 '
180 '                "TURN3"
185 '
190 _VSW(3): ON ERROR GOTO 140                         'Print off screen.
195 _INTSET(1,0): _SLFONT(FONT%(0),"SSER70")
200 _TEXT(55,0,"1=TURN",FONT%(0),6,6,1)                'Three choices.
205 _TEXT(180,0,"2=TURN",FONT%(0),6,6,1)
210 _TEXT(80,15,"RIGHT",FONT%(0),6,6,1)
215 _TEXT(210,15,"LEFT",FONT%(0),6,6,1)
220 _TEXT(60,180,"3 = GO STRAIGHT",FONT%(0),6,6,1)
225 CCLEAR: _LDPWAIT(1062): _VSW(2): BEEP              'Show choices.
230 LIMIT = 1063: GOSUB 20                             'Don't wait long.
235 IF A$ = "1" THEN 350
240 GCOLOR ,,4: GCLEAR 4: IF A$ = "3" THEN 300         'Not right: screen red.
245 IF A$ = "2" THEN 265                               'What's your choice.
250 _TEXT(120,100,"? ? ?",FONT%(0),6,0,5,1)            'No selection.
255 GOTO 270
260 '
265 _TEXT(75,100,"TURN LEFT??",FONT%(0),6,0,3,1)
270 _LDPSTART(1064,1065) :PAUSE 3                      'Scene of Helmlich
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```
                                                            Maneuver
275 GCLEAR 8: GCOLOR ,,8: _LDPWAIT(1066)
280 _TEXT(65,120,"CRUNCH!",FONT%(0),4,0,10,3)
285 MSG$ = "SORRY, NAME. WRONG WAY!"
290 PRGM$ = "TURN3": GOTO 95                                'BAD END
295 '
300 _TEXT(60,100,"GO STRAIGHT??",FONT%(0),6,0,3,1)
305 _LDPSTART(1067, 1068): PAUSE 2                          'Run between tables.
310 GCLEAR 8: GCOLOR ,,8: _LDPWAIT(1069)
315 GCOLOR ,,4: GCLEAR 4
320 _LDPSTART(1070,1071)                                    'Jump the gravy.
325 _TEXT(45,100,"RUN, NAME, RUN!",FONT%(0),6,0,3,1)
330 PAUSE 14: GCLEAR 8: GCOLOR ,,8                          'Music behind graphic.
335 _LDPWAIT(1072): MSG$ = "THIS IS THE 'CHECK, NAME!"
340 PRGM$ = "TURN3": GOTO 95                                'BAD END
345 '
350 GCLEAR 8: POINTS = 3490: GOSUB 65: CCLEAR
355 _LDPWAIT(1073)
360 LOCATE(15,20): CCOLOR 4,2,2: PRINT " WARNING "          'Print flashing.
365 LOCATE(6,21): CCOLOR 4,2,0
370 PRINT "TAKE POSITIVE ACTION OR DIE!"
375 LOCATE(9,22): PRINT "TYPE YOUR RESPONSE NOW:"           'MINI-EDITOR:
380 CCOLOR 4,0,0: C% = 15: L% = 23                           'Set col & line.
385 RESP$ = "": EVAL INKEY$: CURSOR ON                       'Initialize.
390 _LDPFRM(F#): IF F# > 1074 THEN 450                       'Is time up?
395 LOCATE(C%,L%): A$ = INKEY$: IF A$ = "" THEN 390          'Key pressed?
400 IF A$ = CHR$(13) THEN 450                                'Return key?
405 IF A$ <> CHR$(150) OR LEN(RESP$) = 0 THEN 425            'Left arrow key?
410 RESP$ = LEFT$(RESP$, LEN(RESP$) - 1): C% = C% - 1        ' then back up,
415 IF C% < 0 THEN C% = 39: L% = L% - 1                      ' update cursor,
420 LOCATE(C%, L%): PRINT " ";: GOTO 390                     ' erase character.
425 IF A$ < CHR$(32) OR A$ > CHR$(122) THEN 390              'Valid character?
430 IF LEN(RESP$) > 60 THEN 390                              '60 character limit?
435 RESP$ = RESP$ + A$: LOCATE(C%, L%): PRINT A$             'Add character typed,
440 C% = C% + 1: IF C% > 39 THEN C% = 0: L% = L% + 1         ' update cursor.
445 GOTO 390                                                 'Check the time.
450 CURSOR OFF : CCLEAR                                      'Time's up.
455 FOR K% = 1 TO LEN(RESP$) - 4                             'Search response
460 IF MID$(RESP$,K%,5) = "FLOOR" THEN 510                   'for right answer.
462 IF MID$(RESP$,K%,5) = "floor" THEN 510                   'lower case, too.
465 NEXT K%: _LDPWAIT(1075)                                  'Must be wrong.
470 GCOLOR ,,4: GCLEAR 4: _LDPSTART(1075,1076)               'New threat!
475 PAUSE 1: GCLEAR 8: GCOLOR ,,8
480 PAUSE 5: GCOLOR ,,4: GCLEAR 4: _LDPSRCH(1078)            'Looks grim.
485 PAUSE 5: GCLEAR 8: GCOLOR ,,8
490 _TEXT(100,120,"LOST HAT CHECK STUB!",FONT%(0),4,0,5,2)   'It's all over.
495 MSG$ = "TOO BAD, NAME.": PRGM$ = "TURN3"
500 SCORE = SCORE - 3490: GOTO 95                            'Can't keep points if
505 '                                                        'restarting this module.
510 _LDPWAIT(1079)
515 _TEXT(115,170,"WISE!",FONT%(0),4,0,3,1)
520 PAUSE 30: CCLEAR: GCLEAR 8
525 CHAIN /V "WYSTEP", 170                                   'What's next?
```

Program 8:

```
150 DIM FONT%(1600): CONSOLE 40: CURSOR OFF                  'Cold start.
155 GCOLOR ,,8: GCLEAR 8: CCOLOR 6,0,0: CCLEAR               'Restart entry point.
160 _LDPINIT: _LDPOUT (&H51): _INTSET(1,0)
165 _LDPSTART(1080,1081)
170 CHAIN /V/M "SUBSET"                                      'Warm start entry point.
175 '
180 '                     "WYSTEP"
185 '
190 _VSW(3): ON ERROR GOTO 140
195 _SLFONT(FONT%(0), "SSER70")
200 _TEXT(20,180,"1 = WATCH YOUR STEP",FONT%(0),6,6,1)
205 _LDPWAIT(1082): _VSW(2): BEEP                            'Only one choice.
210 _LDPWAIT(1083): LIMIT = 1084: GOSUB 20                   'Question is 'when'.
215 IF A$ = "1" THEN 230 ELSE _LDPWAIT(1085)                  'Pressed at right time?
220 MSG$ = "YOU DID'NT WATCH YOUR STEP.": GOTO 280
225 '
```

(continued)

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Circle 48 on inquiry card.

```
230 SCORE = SCORE + 12380: GOSUB 45
235 LIMIT = 1086: GOSUB 20: GCLEAR 8                 'Don't hold key down.
240 IF A$ = "1" THEN 260                             'It's a trap.
245 MSG$ = "TOUGH LUCK, NAME."                       'Can't keep points if
250 SCORE = SCORE - 12380: GOTO 280                  'restarting this module.
255 '
260 LOCATE(9,20): PRINT "YOU'RE NOW IN A POSITION"
265 LOCATE(12,21): PRINT "TO WIN THIS GAME. . ."
270 CHAIN /V "WEIGHT", 170                           'One more test.
275 '                   STREET SCENE
280 GCOLOR ,,4: GCLEAR 4: CCLEAR
285 _LDPSTART(1087, 1088)
288 PAUSE 1: GCLEAR 8: GCOLOR ,,8                    'Wait for disc access.
290 PAUSE 2: GCOLOR ,,4: GCLEAR 4: PAUSE 1           'Show, then mask picture,
295 _LDPSRCH(1089): PAUSE 2: GCLEAR 8: GCOLOR ,,8    'but play the sound.
300 _TEXT(105,130,"TAXI!",FONT%(0),4,0,5,2)          'Grim scene.
305 PRGM$ = "WYSTEP": GOTO 95                        'BAD END
```

Program 9:

```
150 DIM FONT%(1600): CONSOLE 40: CURSOR OFF          'Cold start.
155 GCOLOR ,,8: GCLEAR 8: CCOLOR 6,0,0: CCLEAR       'Restart entry point.
160 _LDPINIT: _LDPOUT (&H51): _INTSET(1,0)
165 _LDPSTART(1090,1091)
170 CHAIN /V/M "SUBSET"                              'Warm start entry point.
175 '
180 '                   "FARE"
185 '
190 _VSW(2): ON ERROR GOTO 140
195 _INTSET(1,0): _SLFONT(FONT%(0),"SSER70")
200 CCLEAR: LOCATE (6,20?
202 PRINT "JUST ANSWER THIS ONE QUESTION. ."
205 _LDPWAIT(1092): CCLEAR: _LDPTWAIT(14077)
210 LOCATE(1,20)
212 PRINT "WHAT IS THE FARE FOR THE FIRST 1/16 MILE?"
215 LOCATE(0,22)
217 PRINT "YOU HAVE 20 SECONDS TO TYPE YOUR ANSWER."
220 C% = 18: T = 15: EVAL INKEY$: CURSOR ON          'MINI-EDITOR.
225 _LDPFRM(F#): IF F# > 1093 THEN 290               'Time up?
230 NT = (1094 - F#)\32                              'New time remaining.
232 IF T = NT THEN 245 ELSE T = NT                   'Different from last time?
235 CURSOR OFF : CCOLOR 4, 2                         'Then print new
240 LOCATE(9,22): PRINT SPACE$(-(T<10));T;           'time, flashing.
242 CCOLOR 6,0: CURSOR ON
245 LOCATE(C%,23): A$ = INKEY$: IF A$ = "" THEN 225  'Key press?
250 IF A$ = CHR$(13) THEN 290                        'Return key?
255 IF A$ <> CHR$(150) OR LEN(W$)= 0 THEN 270        'Backing up?
260 W$ = LEFT$(W$) - 1): C% = C% - 1                 'Take character away
265 LOCATE(C%,23): PRINT " ";: GOTO 225              'and erase it.
270 IF A$ < CHR$(32) OR A$ > CHR$(122) THEN 225      'Valid character?
275 IF LEN(W$) > 20 THEN 225                         '20 character limit?
280 W$ = W$ + A$: LOCATE(C%,23): PRINT A$;           'Add character typed,
285 C% = C% + 1: GOTO 225                            'update cursor, check
                                                     time.
290 CCLEAR: CURSOR OFF : _LDPWAIT(1095)              'Time's up.
295 FOR K% = 30 TO 70 STEP 20: PAUSE 10              'No right answer.
300 _TEXT(165 + K%/2, K%,"WRONG!",FONT%(0),4,0,5,2)
305 NEXT K%: _LDPWAIT(1096): GCLEAR 8                'Pothole gaping ahead.
310 LOCATE(5,24): PRINT "P = PLAY AGAIN      E = END";
315 _LDPFRM(F#): IF F# > 1097 THEN 325               'You can watch til end
320 A$ = INKEY$: IF A$ = "" THEN 315                 'of segment or take
325 GCOLOR ,,1: GCLEAR 1: CCLEAR: _VSW(0)            'shortcut out (P or E).
330 IF A$ <> "" THEN _LDPSTART(1098,1099)            'Music behind graphic.
335 _TEXT(50,40,"BETTER LUCK",FONT%(0),6,0,5,1)      '(Actually, any key leads
340 _TEXT(65,60,"NEXT TIME.",FONT%(0),6,0,5,1)       'to this final frame.)
345 _TEXT(30,100,"TO PLAY AGAIN",FONT%(0),6,0,5,1)
350 _TEXT(70,120,"TYPE",FONT%(0),6,0,5,1)
355 _TEXT(150,120,"BIG DINNER.",FONT%(0),4,6,5,1)
358 GOSUB 45                                         'Show final score
360 CCOLOR 4: LOCATE(18,22): INPUT /L, RESP$
365 IF RESP$ = "BIG DINNER" OR RESP$ = "big dinner" THEN RUN "FIRSTSEG"
370 GOTO 125                                         'Reset screen and end.
```

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Canon Printer Division

Circle 49 on inquiry card.

The combination of the overlay and RGB graphics makes it possible to add new elements to an existing program.

All of this happens very quickly, and without a "glitch." That is, the combination of the overlay and RGB graphics makes it possible to add new elements to an existing program, weaving them into the action so everything seems normal.

In writing these programs, we discovered that timing was critical. In some instances, we changed the sequence of the disc player and screen commands so that videodisc scenes, graphics, and screen-clearing functions coincided.

We found that the best way to lock in the timing was to use LDPWAIT. The LDPWAIT command suspends program execution until the computer spots the specified videodisc frame. In some cases, we detected as much as one-tenth of a second lag between the appearance of the desired frame and the execution of the command following LDPWAIT. So we "fudged" (prerolled) the frame numbers as needed to improve the timing.

We had to use the Sony Disk BASIC PAUSE statement several times as a fudge factor. PAUSE 10 is approximately one second.

We might add that in the GRAVY program, we developed a random-question generation sequence with our own (slightly ridiculous) questions and answers from lines 365–440. If you do not like ours you can add your own as long as you do not exceed 40 characters per line.

There are several other examples of how to use a personal computer to reformat an existing disc. Without going into further detail here, we suggest you refer to the listing for additional examples.

Conceptually, there is nothing new about using an existing disc to create a game. The exciting part is that two years ago integrated systems and software support for them were generally unavailable. Today, systems like the SMC-70 are widely available. More importantly, with the kind of software that is also available, you do not need to be an expert to write a program like this. Everything you need is likely to be found in the manual that accompanies the videodisc interface.

For those of you with IBM PCs, Visage (12 Michigan Drive, Natick, MA 01760) has just released a universal videodisc controller card, the VDC-1000, which can run with either the consumer or industrial players. At the time of this writing the card was not yet available, thus we had no chance to use it for this game. But we are impressed with the purported features. Some of them include: graphics overlay on any NTSC signal; 15 available colors (including "transparent"); full-sprite animation; data dump from disc to PC memory; frame status; and a keyed-to-frame (TM) feature that links graphics and animation to the video.

For those of you with Apple IIs and IIes, Video Associates Labs (3933 Steck Ave., Suite B109, Austin, TX 78759) has a similar overlay system that has been well received, particularly by the broadcast and industrial video businesses. ■

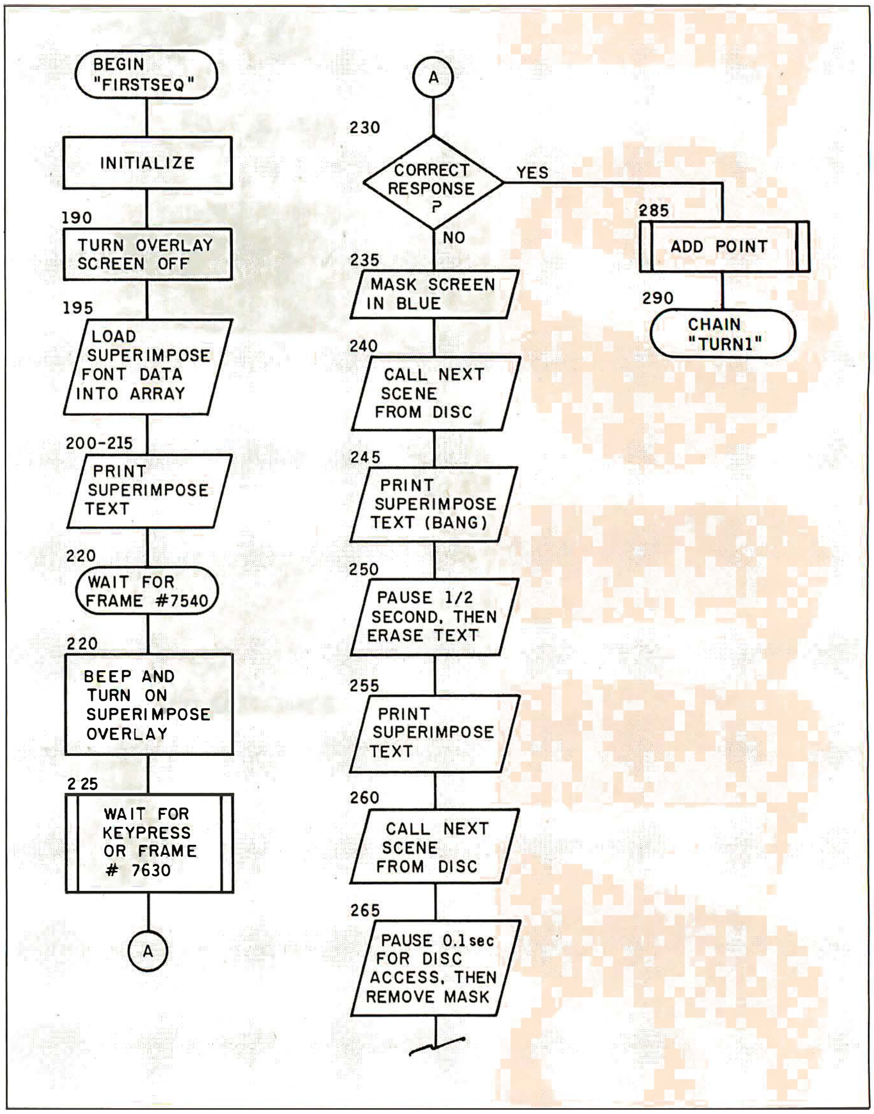
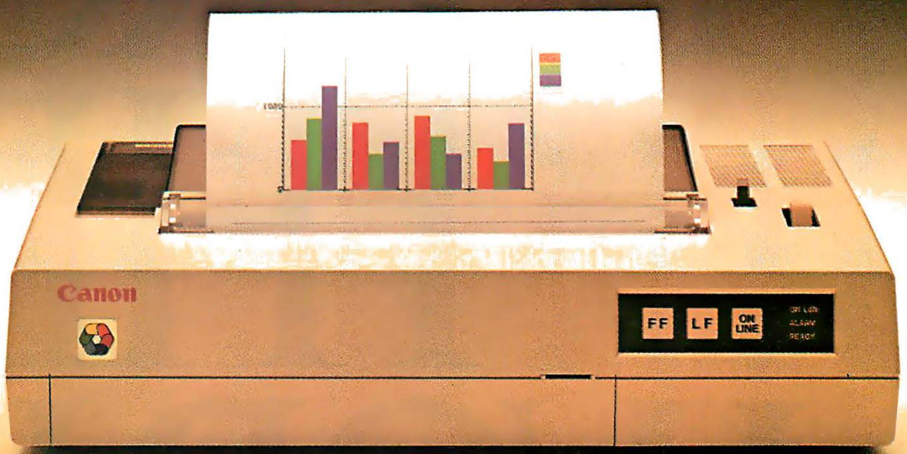


Figure 5: *A sample flowchart for the "FIRSTSEQ" program, one of eight programs in the listing.*

Canon

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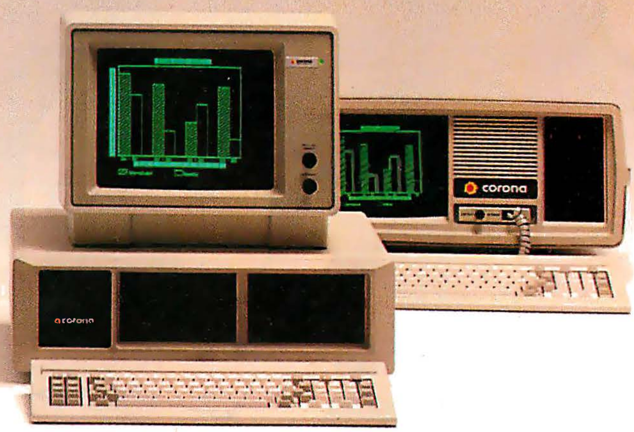
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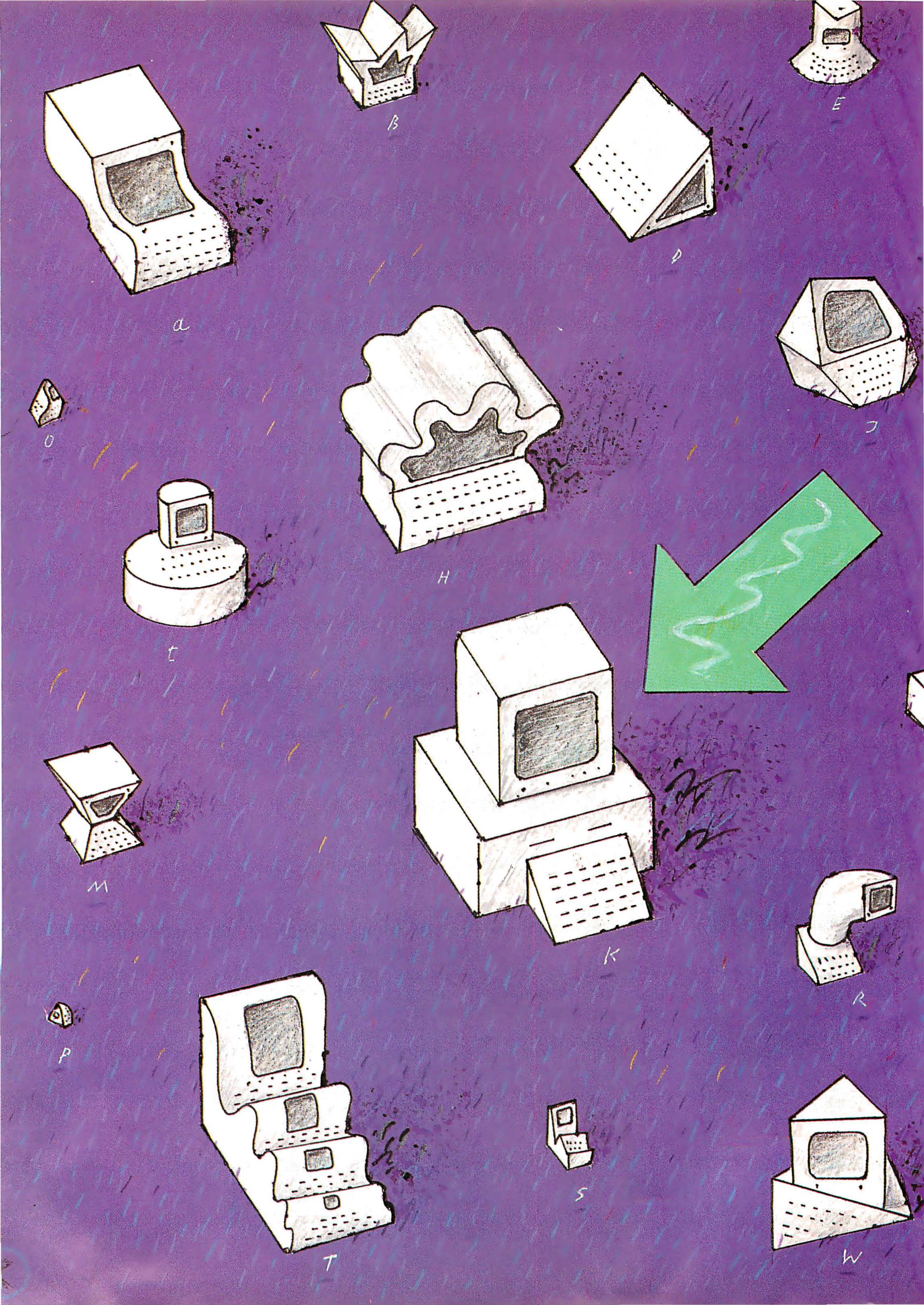
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Reviews

REVIEWER'S NOTEBOOK

Business Solutions Inc., a software house located on Long Island, has been sponsoring contests for integrated software packages running on the IBM PC. Guess whose product usually wins? Business Solutions' Jack2, a descendant of its Apple II product called The Incredible Jack, has been the subject of some impressive claims.

For the most part, the claims about this $495 program seem to stand up to scrutiny. Jack2 is a database-management program that can handle spreadsheet calculations, word processing, and graphics. All of these functions can be integrated fairly easily. For example, a letter, or database report, can include several different "blocks." One block could be a single record from a database; another block might be a small spreadsheet; a third, a bar graph. When one item of information changes, the spreadsheet and bar graph can change automatically. All this power is fairly easy to set up, too.

Jack2 has two problems, though. If you take any *one* of its four capabilities—database management, spreadsheet, word processing, or graphics—and look at it by itself, none is close to being as good as single-function programs such as pfs:Write or Multiplan. And second, the program runs on the p-System, not on PC-DOS. This means that you're going to have trouble transferring information from your spreadsheets, word processors, and databases running on MS-DOS. Business Solutions has announced the availability of a utility program that can transfer data from and to PC-DOS files, but we have not received it yet. A review of Jack2 will appear here soon.

Someday we'll have supersophisticated debugging programs that will allow us to customize our software exactly the way we want it. That day may not come too soon, but for now we are fortunate to have keyboard modification programs such as ProKey. The latest version of ProKey (version 3.0) for the IBM PC sells for $130 and allows you to substitute any combination of keystrokes for almost any key on the IBM keyboard. For example, in WordStar, you can change the Delete and Backspace keys into *real* Delete and Backspace keys. Or one keystroke can be used to insert your return address into a letter. And in spreadsheet programs, ProKey's "macro" key sequences are easier to use than those of Lotus's 1-2-3.

And that's not all. Another program in the ProKey package called Layout lets you easily change the layout of the IBM keyboard. For example, you can change the dreaded Backslash key into a Shift key, just like it's supposed to be, or you can set up a Dvorak keyboard. One problem, though, is that while most of the ProKey programs run on most of the IBM compatible systems, the Layout program is one of the few programs I've found that seems to run only on the IBM.

This month Allen Munro looks at the Sage II and IV, a 68000-based family of machines that has received some good notices elsewhere in this magazine.

Mark Dahmke looks at the Compaq Plus, the hard-disk version of the successful portable IBM clone.

Speaking of the IBM PC, we ran an article last year about a 68000 board for the PC produced by a company called Sritek ("Modular Architecture," by Sudha Kavuru, June 1983, page 194). Since this board comes with the XENIX operating system, we had Steven H. Barry and Randall Jacobson, our UNIX experts, report on it.

One product that has received tremendous raves all over the industry is Turbo Pascal, a powerful, easy-to-use version of Pascal for the IBM PC and CP/M-based machines. Tom Wadlow checks out whether the praise is deserved.

While we're on the subject of languages, we have Jordan Bortz and John Diamant reviewing two LISP systems: muLISP and IQLISP. Messrs. Bortz and Diamant examine how much intelligence—artificial or otherwise—went into these products.

And Richard Shuford takes a look at the Smith-Corona L-1000, a descendant of the TP-I, the first really affordable daisy-wheel printer. Richard reports on whether things have gotten better at Smith-Corona since the TP-I came on the market.

—*Rich Malloy, Product-Review Editor*

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The Sage II and Sage IV Computers

The Sage computers display the power of the p-System

BY ALLEN MUNRO

Some personal computer users like to claim that they have no need for greater computing power. They say that a Z80-based system with 64K bytes of RAM (random-access read/write memory) can handle all the tasks that most people would ever want to do on a computer. With all due respect, such users are letting their current systems set the limits of their imaginations.

Those who adopt a personal computer that uses the powerful 32-/16-bit Motorola MC68000 chip (32-bit internal data bus, 16-bit external data bus), such as the Sage II or Sage IV, are likely to discover new computing potential that they will soon decide they would rather not live without.

Does it make sense to put more than one user on a microcomputer? Probably so, if you are paying for the system but won't actually be using it. Probably not, if you want to use it yourself.

The Sage II and Sage IV let you go either way. The 68000 was originally designed as a minicomputer chip and can support multiple- or single-user systems. The standard operating system on the Sage is the UCSD p-System, a single-user computer system. Sage lets you optionally install a multiuser version of the operating system, in which multiple users have access to copies of the p-System, each in his or her own memory partition.

HARDWARE

The two Sage computer models are virtually identical machines from the viewpoint of the applications software and operating system. Sage Computer Technology offers a finely graded series of systems solutions ranging from a single floppy-disk Sage II with 256K bytes of RAM through a variety of dual floppy-disk Sage II systems, to a Sage IV system with one floppy disk, a 40-megabyte Winchester hard disk, and 1 megabyte of RAM.

The crucial difference between a Sage II and a Sage IV system is that a Sage II can be expanded up to 512K bytes of RAM and has only floppy-disk drives, while a Sage IV can have up to 1 megabyte of RAM and has at least one hard-disk drive. A Sage II has two serial ports, one for the terminal and another for a modem or serial printer, and one parallel port. A Sage IV has these peripheral interfaces plus an IEEE 488 instrumentation bus and four serial interfaces for the connection of terminals in a multiple-user mode.

Both the Sage II and the Sage IV can be used as single-user or multiuser machines. The Sage II can support two users (with the modem port configured for a second terminal) and the Sage IV can support up to six users. As many as 15 tasks can be run, which means you can run some extra programs that don't require a terminal, such as printing. Running either machine in a multiuser mode requires the installation of the Sage multiuser environment, a task likely to daunt anyone unfamiliar with the p-System or microcomputer systems in general.

When the Sage II first arrived, I was impressed that the computer arrived in a packaging box not much larger than the one used for an Apple IIe. I was even more impressed when I opened the box and found that almost all the space was taken up by foam padding and documentation. The Sage II itself is smaller than an Apple IIe. Here is a computer with 512K bytes of memory installed, two dual-sided 5¼-inch 80-track disk drives, each with a 640K-byte capacity, and the whole thing weighs only 16 pounds. (The Sage IV weighs 20 pounds.)

The Sage has no bit-mapped graphics capability built in. It communicates to the user through a separate terminal, connected through an RS-232C serial port. If your applications require graphics, you can purchase a terminal with graphics capability. Sage's approach to graphics has the advantage that only those users who require the capability must pay for it. It also makes it possible for users to select exactly the graphics resolution and color they require and can afford. It has the disadvantage that there will be few applications available off the shelf for any particu-

(continued)

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lar combination of Sage plus graphics terminal. In fact, Sage's approach to graphics is probably reasonable only for those who are prepared to program their application themselves.

The Sage printer port supports Centronics-type parallel-printer interfaces. I had no trouble using my Epson MX-80 to print from the Sage, either by using the file-manipulation utility (the Filer) to transfer text to the printer, or from my own programs. To use any printer with the available applications, find out whether the printer is supported by the software vendor, and, if so, how the correct printer parameters can be installed for that software.

I had some trouble when I decided to hook up the Sage II to an NEC Spinwriter Model 5525 with a serial interface. Thanks to many previous experiences trying to get RS-232C devices to communicate, and to the use of a Carroll breakout box (the RS-232 Line Tester, available from Carroll Touch Technology, 1212 Hagan St., Champaign, IL 61820), a friend and I were able to drive the printer from the Sage's modem port after about two hours of work.

The fact that it took time to complete this hookup is not a criticism of Sage in particular. There simply are not enough constraints on how manufacturers can implement the RS-232C standard to assure compatibility.

Neither of the Sage computers is particularly noisy. Both have fans that seem to do a good job getting the warm air out of the beige-and-black cabinets that house the computers, and they aren't loud enough to interfere with normal conversation. You just notice the sound if you happen to think of it. The hard-disk-equipped Sage IV made a high-pitched whine for the first 20 hours of operation, but it's been quiet since then.

Both Sages seem to be reliable. When the Sage IV first arrived, it had a dead hard-disk drive. The carton looked as though it had been handled pretty roughly, and Winchester drives just aren't built to be abused. A call to the Sage service department was promptly answered by someone who suggested some simple tests. Sure enough, there was something wrong with the drive. The Sage service department sent me the replacement unit at the same time I sent the defective unit to them.

The new Sage IV arrived in fine working order. The Winchester disk comes formatted and had been set up with all the necessary volumes (virtual disks) and floppy disks for p-System use. The system is set up to boot from the hard disk, but a simple back-panel switch setting change makes it possible to boot from a floppy disk, if you'd rather.

PERFORMANCE

The only really reliable way to compare the performance of two computer systems is to actually use them. Benchmark programs are too narrowly focused to fully reflect system performance in the real world.

That caveat stated, four benchmarks are reported in table 1. Although any single benchmark should be taken with a grain of salt, a group of benchmarks may reveal a consistent trend. For comparison, the benchmark results for the IBM PC XT and the Apple IIe are presented here as well.

Virtually the same operating systems were used for all of the tests. Three of the benchmarks—the Pascal version of the Sieve of Eratosthenes, the floating-point benchmark, and the disk-transfer rate test—were performed using versions of the UCSD p-System. Both the Sage and the IBM PC XT ran under version IV.1 of the p-System. The Sage's p-System was produced by SofTech Microsystems; the IBM's came from Network Consulting Inc. (NCI). The Apple IIe ran under Apple Pascal version 1.1, an implementation of UCSD Pascal version II.0. (A version IV p-System is available from SofTech Microsystems for the Apple, but it is not widely used because it costs more and runs significantly more slowly.)

The Modula Sieve test for all three machines was done with the Modula operating system from Volition Systems of Del Mar, California. Volition uses a modified version of the UCSD Pascal Operating System, version II, as the basis for its operating system in support of Modula-2.

The first benchmark presented in table 1 is the Sieve, written in Pascal, as presented by Jim Gilbreath and Gary Gilbreath in "Eratosthenes Revisited: Once More through the Sieve" (January 1983 BYTE, page 283). This classic benchmark tests a computer system's speed at performing loops. As the results show, the IBM PC XT takes almost 2.5 times as long as the Sage machines, and the Apple IIe takes over 6.8 times as long.

The Modula version of the Sieve is also taken from the Gilbreaths' article. Here, running under a slightly different operating sytem, the Sage performs more than 3.5 times as fast as the IBM PC XT, and almost 6.7 times as fast as the Apple. This particular benchmark may actually be the fairest comparison of the speeds of the three machines because all were performed using the same operating system, based on UCSD Pascal version II.

This operating system may be a bit faster than SofTech's version IV.1. The Modula operating system includes a Pascal compiler as well as the Modula-2 compiler. When the Pascal version of the Sieve benchmark was compiled on the Sage in this operating system, it ran in 69.3 seconds, a little faster than it did under version IV.1.

The third set of benchmark figures in table 1 is the result of a Pascal floating-point benchmark adapted from a similar program written in C. The original program appeared in "Comparing C Compilers for CP/M-86" by Jerry Houston, Jim Brodrick, and Les Kent (August 1983 BYTE, page 82). The Pascal version used for this comparison appears in listing 1. Here the IBM PC XT took about 1.9

(continued)

Table 1: *Speed (in seconds) for four benchmarks, using UCSD Pascal.*

	Sage II/IV	IBM PC XT	Apple IIe
Pascal Sieve	74.8	184.6	512.1
Modula Sieve	66.7	246.0	444.6
Pascal Floating Point	73.6	139.4	506.8
Pascal Disk Transfer			
Floppy disk	42.9	44.6	53.5
Hard disk	7.9	8.7	75.6
RAM disk	0.6	2.1	

AT A GLANCE

Name
Sage II

Manufacturer
Sage Computer Technology
4905 Corporate Way
Reno, Nevada 89502
(702) 322-6868

Components
Size:
 4 by 12.5 by 17 inches
Processor:
MC68000, 8-MHz
Memory:
256K bytes standard
512K bytes max
Mass Storage:
half-height floppy disk, double-sided
40-track (IBM PC compatible)
80-track (640K bytes each)
Interfaces:
parallel, serial, modem

Software
Operating system:
UCSD p-System
Included software:
Word/7 Text Processing System
Teletalker Communications

Optional Hardware
Sage Terminal (Qume 102), other terminals RAM expansion units to above maximums

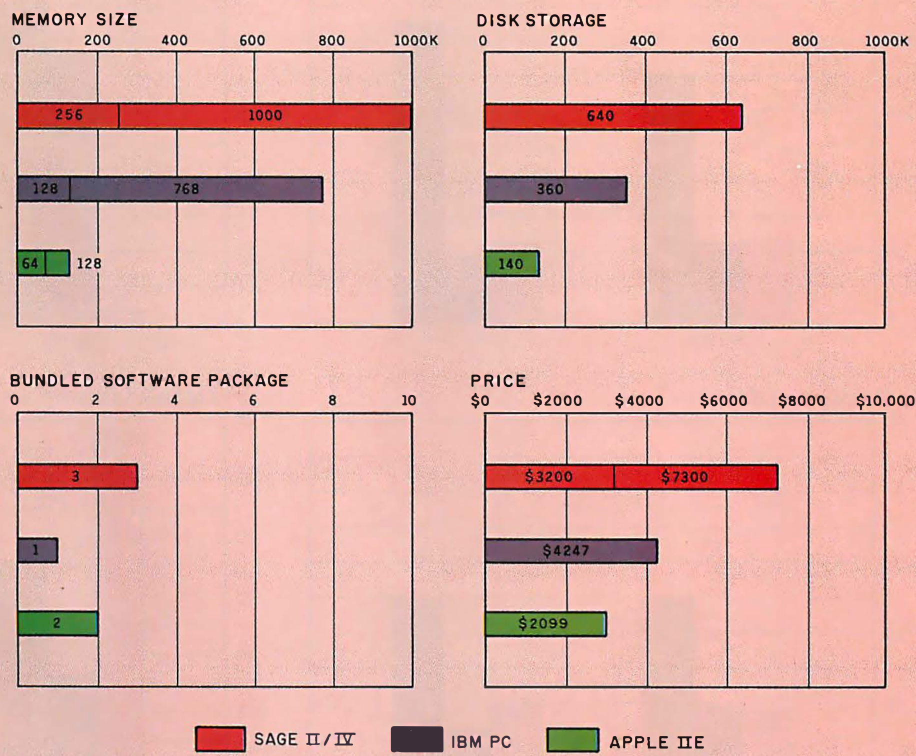
Optional Software
Pascal compiler, Timberline spreadsheet, 68000 assembly language, and over 200 commercial application packages from a variety of software vendors.

Operating Systems
10 available, including CP/M-68K, IDRIS, Modula

Prices
1 floppy-disk drive, 256K bytes RAM $3200

Options
additional floppy-disk drive $700
additional 256K bytes RAM (to 1 megabyte on Sage IV) $500
Sage terminal (Qume) $590

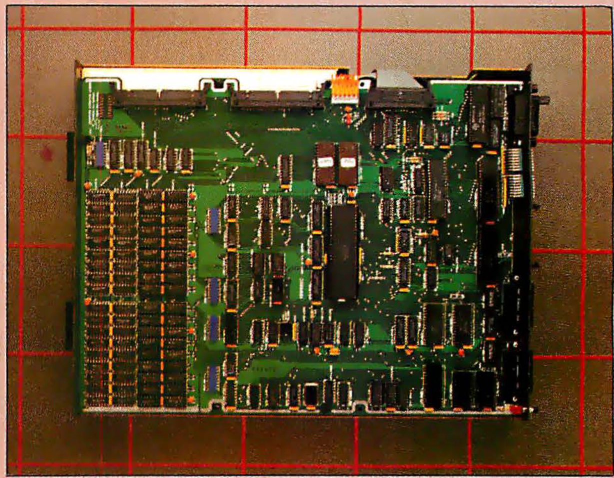




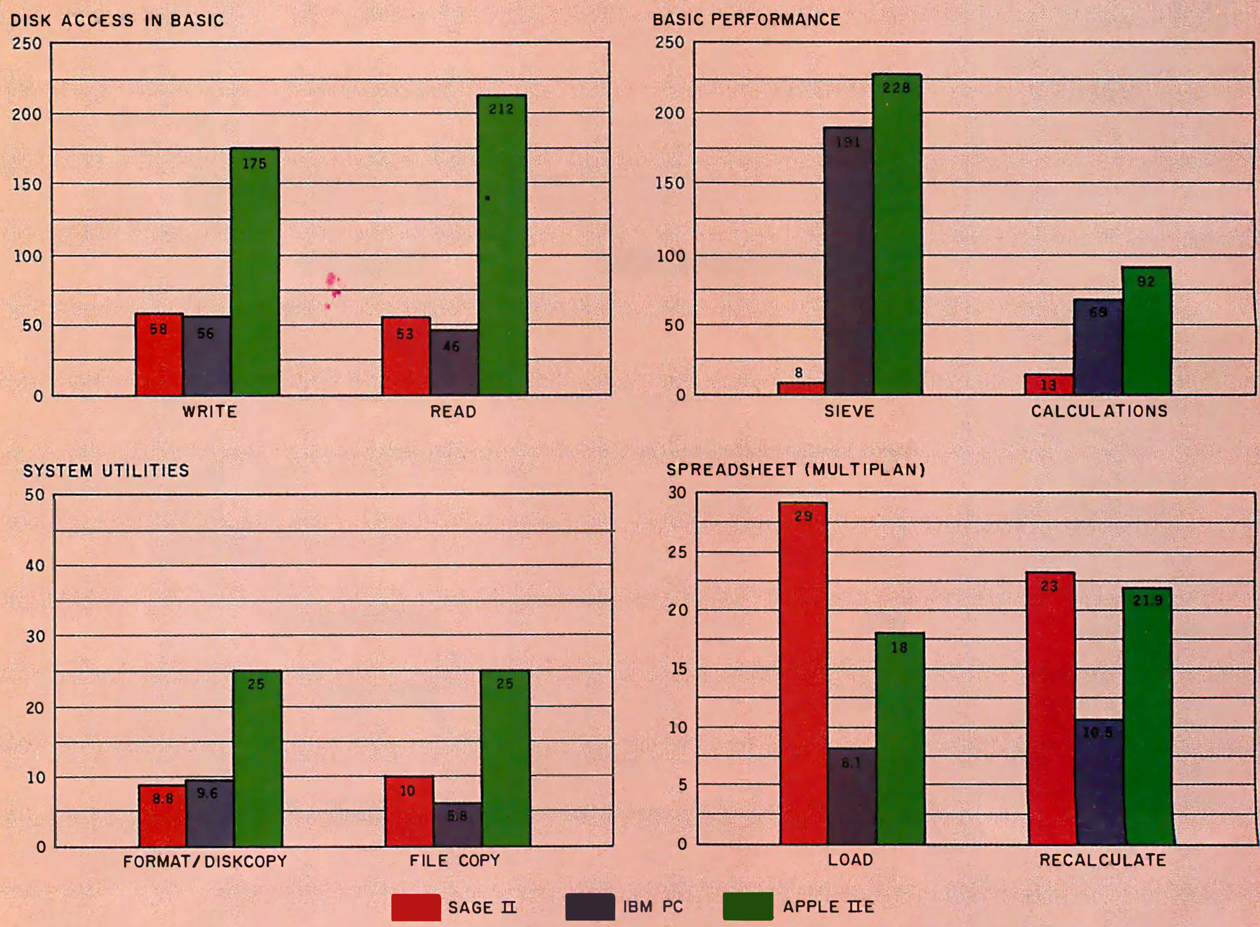
The memory graph shows the standard and optional memory available for the computers under comparison. The graph of disk-storage capacity shows the highest capacity of a single floppy-disk drive for each system. The bundled software packages graph shows the number of software packages included with each system. The price graph shows the list price of a system with two high-capacity floppy disk drives, a monochrome monitor, graphics and color-display capability, a printer port and a serial port, 256K bytes of memory (64K bytes for 8-bit systems), the standard operating system for each system, and the standard BASIC interpreter for each system.



The rear panel of the Sage II/IV.



Top view of the Sage II/IV with the cover removed.



The graphs for disk access in BASIC show how long it takes to write a 64K-byte sequential text file to a blank floppy disk and how long it takes to read this file. (See the June BYTE, page 334.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The calculation graph shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers. The system utilities graphs show how long it takes to format and copy a disk (adjusted time for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The spreadsheet graph shows how long the computers take to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left.

All Sage benchmarks were executed on a Sage IV computer with an 8-MHz 68000 microprocessor, 512K bytes of memory, and two 5¼-inch disk drives containing 640K bytes each. The operating system was the UCSD p-System version IV.13.

*Note that a BASIC interpreter is not available for the Sage II/IV. The BASIC tests were executed using the Softech p-System BASIC Compiler, version IV b5-4. The compiled code was then interpreted by the p-System. The BASIC calculation test was run using 64-bit real arithmetic.

The format/disk-copy operation on the Sage involves three separate operations: format, zero directory, mirror-image copy. The Timberline spreadsheet, version 1.0, was used for the Sage spreadsheet tests.

times longer than the Sage and the Apple IIe took about 6.9 times longer.

Finally, I wrote a simple program, shown in listing 2, to test the disk-transfer rates of the three machines. The program opens a file for reading and another file for writing and then repeatedly reads 25K bytes (50 blocks in the p-System) and writes 25K bytes to the same device. The time it took all three computers to perform this action of a floppy disk was remarkably similar. The Sage was only slightly faster than the IBM PC XT, and only 1.25 times as fast as the Apple. Hard-disk speeds were also similar for the Sage and the IBM, but the Apple's Corvus 11-megabyte hard disk was much slower—even slower than the Apple's floppy disks. This result was puzzling. I knew that the Corvus made working with disk-intensive programs a lot faster on the Apple. Why did the benchmark show exactly the opposite result? The answer, of course, is that disk-transfer speed is not an important part of disk performance for most personal computer applications. Disk-access time usually is much more important.

The last line of data for the disk-transfer benchmark compares the Sage and the IBM when a RAM disk (virtual disk in semiconductor memory) is used. Here the Sage again enjoys a 3 to 1 speed advantage. This result probably reflects the superiority of the MC68000's memory-addressing method over the 8086 family's.

Listing 1: A *simple floating-point benchmark.*

```
program fpbench;
const const1 = 3.141597;
      const2 = 1783.9032;
      count = 10000;
var a, b, c: real;
    i: integer;
begin
  a := const1;
  b := const2;
  for i := 1 to count do
    begin
      c := a * b;
      c := c / a;
      c := a * b;
      c := c / a;
      c := a * b;
      c := c / a;
      c := a * b;
      c := c / a;
      c := a * b;
      c := c / a;
      c := a * b;
      c := c / a;
      c := a * b;
      c := c / a;
    end;
  writeln ('Done ', count)
end.
```

Listing 2: A *disk-transfer speed benchmark.*

```
program testdisk;
  var fromblocks, toblocks, numblocks, i: integer;
      infile, outfile: file;
      anarray: packed array [0..25599] of char; (* 50 blocks worth *)
begin
  writeln ('test disk')
  from blocks := 0; toblocks := 0;
  reset (infile, 'test.text');
  rewrite (outfile, 'test.data');
  for i := 1 to 10 do
  begin
      numblocks := blockread (infile,anarray,50,0);
      fromblocks := fromblocks + numblocks;
      numblocks : = blockwrite (outfile,anarray,50,0);
      toblocks := toblocks + numblocks
  end;
  close (outfile, lock);
  writeln (fromblocks,' blocks read; ',toblocks,' blocks written.')
end.
```

SOFTWARE

The Sage II and IV, with the operating system and available applications software, are very much p-System machines. The UCSD p-System is provided with both computers. Also available are Pascal and FORTRAN compilers and a 68000 assembly language that produces linkable assembly code. This means that computation-intensive portions of programs can be written in assembly for speed, while the bulk of the programs are written in Pascal for readability and compactness.

A number of typical p-System utilities are included, such as a cross-reference program and a teletalk utility for transferring files over the RS-232C interface to another p-System computer. The most important utility is a BIOS (basic input/output system) manipulation utility called SAGE4UTIL. This program is the one that lets you change features such as bps (bits per second) rate and number of stop bits for the RS-232C interface or treat one of the floppy-disk drives as an IBM PC-format drive.

Also included is Word7, a word-processing program. Word7 creates and accesses p-System files of type text. The files are not given the ".TEXT" suffix that other p-System text editors assign to the names of files they access and create. Instead, Word7 appends a "/D" to the name of the document. It is simple to use the Filer utility to change the names of files between the "/D" and ".TEXT" versions, making it possible to work on the same files.

Unlike other p-System editors, such as the standard editor and Volition's Advanced System Editor, Word7 provides filing and printing functions from within the program. Word7 is not as mode-

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Table 2: *A comparison of Word7 on the Sage IV with WordStar 3.3 on the IBM PC. The tests measure (1) how long it takes to load a 4000-word document from a floppy disk, (2) how long it takes to save the document to a floppy disk, (3) how long it takes to find the last word in the document, and (4) how long it takes to scroll through the document to the end.*

Test	Sage IV	IBM PC
Software	Word7	WordStar 3.3
1. Document load	7.7	9.9
2. Document save	13.1	24.2
3. Search	7.2	10.5
4. Scroll forward	58.5	41.2

oriented as other p-System editors, although it does have two basic modes, one for insertion and the other for exchanging or overstriking text, much like word-processing programs such as WordStar. Rather than presenting a one-line menu of available options, as the standard editors do, Word7 requires that the user know which keyboard function keys to use to accomplish tasks like deletion or centering of text.

Both the modeless and mode-type editors have adherents. There may be some advantage to a system such as Sage's that allows users to share the same text files even though they use different editors.

Table 2 shows a comparison of Word7 running on a Sage IV with WordStar running on an IBM PC. As you can see, Word7 is somewhat faster at loading a document and searching, quite a bit faster at saving a document, and somewhat slower at scrolling forward. It should be noted that the Sage IV was equipped with a 640K-byte floppy-disk drive, while the IBM PC had two 320K-byte floppy-disk drives, 512K bytes of RAM, a monochrome monitor and adapter, and DOS 2.0.

Configuration

The Sage is an excellent p-System development machine because it is faster than any other widely available p-System computer. Furthermore, its floppy-disk drives can be configured to read a large number of disk formats in addition to its own 1280-block (640K-byte) 80-track format. Other formats the Sage can read include IBM PC disks in several formats (double- and single-sided, standard 8-sector, or Network Consulting Inc.'s 10-sector) and the SofTech Microcomputing "universal" medium—280-block disks in IBM PC format. Although Sage does not recommend that its 80-track drives be used for writing to 40-track disks, I found I could ignore the warning messages and safely transfer data from Sage disks to disks that had been formatted on an IBM PC in the standard 640-block (320K-byte) format. To do this, I simply chose the option in the Sage configuration utility program called SAGE4UTIL that let me make on-line changes to the system's BIOS.

The Sage can directly write to the disks of most p-System computer systems that use 5¼-inch floppy disks.

The Sage computers can directly write to the disks of most p-System computer systems that use 5¼-inch floppy disks. For those systems with disks that a Sage computer cannot write to directly, a standard utility program is provided for transfer of files over RS-232C lines.

Not every novice computer user would find it easy to configure a Sage system after unpacking it. In the best of all possible worlds, your friendly and competent computer dealer would be right there beside you, configuring the computer and giving you detailed training on its use. But in the real world, the computer dealer is all too likely to hand over the boxes and wish you luck. When a computer uses a built-in bit-mapped graphics display, it doesn't have to be

(continued)

set up for use with a separate terminal. The Sage, however, does use an external terminal (or up to five of them if the multiuser system is employed), and it has to be configured to treat the terminals of different manufacturers correctly.

Configuring the terminal involves several steps. First, the terminal and the computer must be set to the same communication parameters, such as bps rate. The terminals I received from Sage for use with the machines were set for 9600 bps, while the terminal ports on the Sage were configured for 19,200 bps. To make the serial communications ports compatible, I had to look up tables in two different documents to find the correct switch settings. Compatibility is not a matter of bps rate alone; it concerns the number of stop bits, parity, and length of characters as well. To find out how the terminal's switches should be set, I had to find the information in the documentation of the terminal and also in the Sage manual.

The second part of configuring the system concerns making the necessary software modifications to customize the operating system for your terminal. This requires transferring some files and changing file names to get the appropriate set of terminal parameters to load when the system boots. If you are using a terminal other than one of those for which Sage provides preconfigured files, you will have to first write a new cursor-positioning procedure (GOTOXY) and bind it into the operating system. Then you will have to run a program that lets you customize the terminal parameters. This program sets up a system file that records, for example, which ASCII (American National Standard Code for Information Interchange) character moves the cursor up a line.

The novice user is going to find it takes time and patience to make an unusual terminal work properly with the Sage. Fortunately, Sage does provide the required files for the terminals it sells with the system, as well as many other common terminals. When the Sage II arrived, it came with a terminal labeled Sage. A search of the preconfigured terminal parameter files did not reveal any Sage terminal information. Turning over the keyboard, I found a Liberty Electronics label that identified the terminal as a renamed Freedom 100. The set of terminal-parameter files included one called F100, and that proved to be the one I needed.

Even if the correct files are on your disk, there is no clearly labeled set of instructions describing how to perform the setup. When I began this review, Sage was waiting delivery of new documentation that is said to solve all of the novice user's configuration problems (see the text box "Postscript" on this page for a description of the new documentation), but I would suggest that prospective Sage purchasers who are not familiar with the p-System make sure that they have access to someone who is.

The Verdict

The Sage II and Sage IV computers are wonderful systems for p-System developers and serious p-System users. Sage is trying to appeal to a wider user base by making important types of business-software packages available and through improved user documentation.

If you are committed to the p-System, get one of these machines. If you aren't, but you're in the market for a system that has demonstrated powerful performance, you should check out the Sage II or IV. ■

Postscript

Shortly after this review was prepared, Sage released a new set of documentation for the Sage II and IV and unbundled (or rebundled) its software. The new manuals and packaging go a long way toward eliminating my concern for novice users who might buy a Sage, and make the Sage a good choice for computer users who need extra power or want an inexpensive multiuser system.

Currently, both Sage computers are shipped with the UCSD p-System, communications software, utilities, Word7 word-processing software, two manuals, and a book about using the UCSD p-System.

The new documentation is more attractively packaged than before. Each of the 6- by 8½-inch binders is separately boxed, in the same manner that IBM PC manuals are. The layout of text in the manuals is attractive, with examples from the screen shown against a light green background. Line drawings are used sparingly and with good effect.

The star among the included manuals is *Getting Started*, which is going to save new Sage owners a lot of time and aggravation. *Getting Started* helps you set up the computer and terminal. It tells you how to power up, boot, and back up the system disks, as well as how to execute a demonstration program. The manual also contains primers on the p-System and its disk-file management program, the Filer.

Chapter topics in *Getting Started* include: electronic information services, including Sage's own SageMail; configuring the system for use on nonstandard terminals; setting up the system for use with a variety of printers; using the configuration control program; and setting up the system for multiple users. There is no question that novice Sage users are much better off with this new manual.

The same binder that contains *Getting Started* holds the manual for Word7. Another binder contains the p-System manual, which describes the Filer program and the standard p-System editor. In addition, it describes utility programs for printing files created with the standard editor, reducing a program's start-up time, maintaining the p-System code library, setting up the system for new terminals, and recovering lost files.

Also included is the 500-page *Sage Technical Manual*, which contains everything anyone might want to know about the Sage hardware and low-level operating system features.

Among the new, optional binders are *The p-System Program Development Manual* and manuals for the 68000 assembly language and the Sage debugging tool.

Software that is now available separately for the Sage II and IV includes Pascal and FORTRAN compilers and several spreadsheet programs.

Finally, the standard document set includes a copy of *Personal Computing with the UCSD p-System*, by Mark Overgaard and Stan Stringfellow (Prentice-Hall). Overgaard has been one of the principal forces behind the UCSD p-System since its inception, so this book is likely to contain a great deal of worthwhile information.

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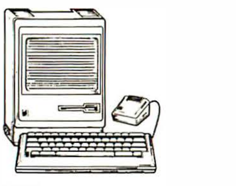
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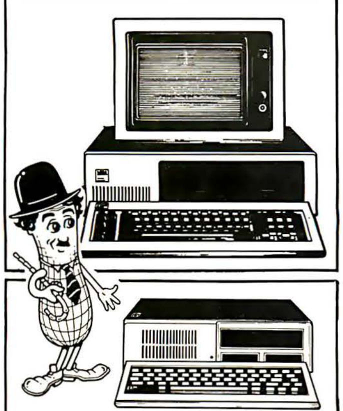
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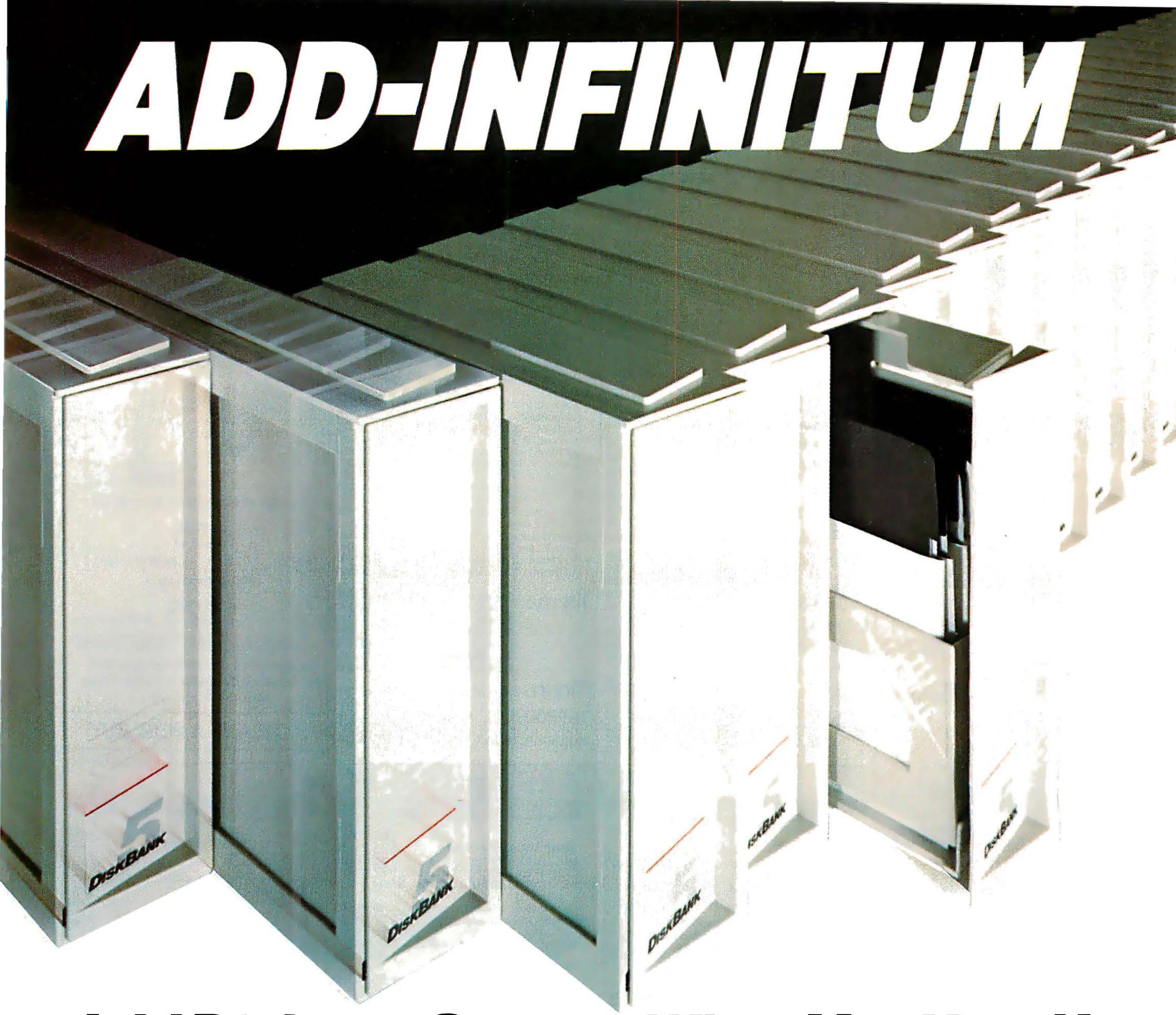
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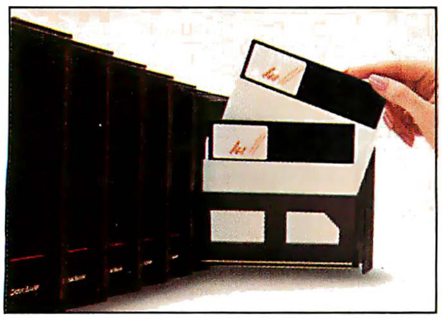
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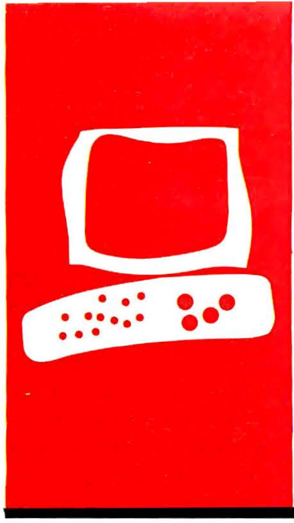
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The Compaq Plus

A transportable computer with fixed disk

BY MARK DAHMKE

The original Compaq portable computer met its designer's goals of portability and IBM compatibility. The Compaq improved on the original IBM Personal Computer (PC) design by incorporating both the monochrome- and color-monitor adapters into one circuit card, and by designing a 120-watt power supply that would meet the needs of any future additions, such as a fixed disk. See my review of the Compaq (January 1983 BYTE, page 30) for more details.

At the time of my visit to Compaq in October 1982, one of the principals of the corporation explained that features like the heavy-duty power supply were added to make it easier to upgrade the unit to fixed-disk operation, but that other problems such as mechanical shock might make it impossible to put a fixed disk in a portable computer.

I am pleased to report on the company's new product, the Compaq Plus, which comes with a shock-mounted 10-megabyte fixed disk.

The Compaq Plus is identical to the original Compaq in every respect, except for the addition of the fixed disk in the right-hand disk drive location. It has a 9-inch green-phosphor display and a Key Tronic keyboard with the same key layout as the IBM PC. And like the original Compaq, the Plus can display true grays and high-quality text, features that are lacking on most graphics adapter cards for the IBM PC. MS-DOS (version 2.02) and Microsoft BASIC are included just as on the Compaq. The fixed-disk controller card occupies one adapter slot, leaving only two for user-installed hardware, such as memory or serial port add-ons. The Compaq Plus also comes with both the monochrome- and color-display adapters and a parallel printer port as standard features.

SOFTWARE

The MS-DOS 2.02 operating system is the same that is supplied with the IBM PC, so in theory, all DOS (disk operating system) functions should be identical. The only difference in the system software is the BIOS (basic input/output system) ROM (read-only memory) that was written by Compaq to duplicate the functions of the IBM PC's BIOS code. The Compaq company seems to have accomplished the goal of maintaining functional compatibility without copying any of IBM's proprietary software. Over the past year I have done extensive assembly-language programming on both the IBM PC and the Compaq and can personally attest to the fact that the BIOS of the Compaq is written in an entirely different manner, yet performs all of the functions of the IBM BIOS.

Adding the fixed disk to the existing Compaq hardware required three steps: designing shock mountings that can be used to protect the fixed disk in a portable (and sometimes hostile) environment; designing a disk-controller card that emulates the functions of the IBM design in such a way that software functionality is maintained; and writing the software device drivers that allow the DOS to record and retrieve information from the fixed disk hardware.

At least two of these three steps are performed by any company that decides to build an add-on fixed disk to the IBM PC or any other computer. The important item to note is that below the operating-system level (the BIOS or other device-driver software), compatibility with application software should not be an issue. The purpose of an operating system is to isolate the user and the application program from the hardware.

In the case of floppy disks, the designers must pay close attention to the software and the hardware design to insure disk compatibility with other computers. However, a fixed disk (as the name implies) cannot be removed from its chassis and does not need to be compatible with any other hardware, at least at the circuit board level. This means that it doesn't matter how the information is stored on the surface of the fixed disk itself because only the hardware that wrote the information will ever read it back.

The exception to this rule occurs when you

(continued)

Mark Dahmke (POB 80266, Lincoln, NE 68501) owns and operates a computer consulting business that specializes in computer graphics, operating systems, and videodisc hardware and software.

Compaq's new manuals are bound in book form so it is not possible to add inserts or revisions as was the case with 3-ring binders.

intend to run several different operating systems on the same fixed disk. The FDISK utility on the DOS disk enables you to partition or allocate the fixed disk to several different operating systems such as CP/M-86, Concurrent CP/M-86, or UCSD Pascal. The first sector of the fixed disk may contain the "boot record," which holds the machine code to load the selected operating system into memory. At the end of the boot record is a partition table that contains the starting and ending "cylinder" address of each of up to four partitions. The implementation of the boot record is the same for the Compaq as for the IBM PC.

As a test of the compatibility of the Compaq Plus, I installed and executed several programs that I have developed for the IBM PC that are written in FORTRAN 77 with extensive assembly-language support for special DOS functions that could not be performed from within FORTRAN. The DOS functions included disk file access, directory access, and direct BIOS calls to read and write characters on the monochrome and color adapter card. All of the code performed as anticipated. After thorough investigation, I can find no DOS- or BIOS-level functions that could create compatibility problems when used with a fixed disk.

Most IBM PC software should run on the Compaq Plus, and Compaq Computer Corporation supplies a list of commercially available software that has been tested on its computer. Regardless of what computer you buy, it is always wise to test the software you intend to use with the computer before writing a check.

Documentation

The Compaq Plus (as well as the standard Compaq) comes with three manuals: *Operations Guide, BASIC 2.0 Reference Guide*, and the *MS-DOS 2.0 Reference Guide*. They are very similar to what IBM supplies with the PC. I am pleased that Compaq is now supplying information on how to open the cabinet, install add-on cards, and set the memory-size switches. The new manual even shows how to remove the processor card to install additional memory (to upgrade the processor board from 128K bytes to 256K bytes). Instructions on adding the 8087 coprocessor are also included.

As someone who is interested in operating systems, I am somewhat concerned that both Compaq and IBM have decided to move the DOS programmer's sections to a separate manual that doesn't come with the computer. While I can understand that the list of DOS function calls and other technical programmer-level information is becoming voluminous with the latest release of MS-DOS/PC-DOS, they could at least include the other manual with the system so programmers don't have to pay extra for information that previously came with the machine.

The descriptions of the individual DOS commands (i.e., ERASE, RENAME, TYPE, CHKDSK) are adequate but not exceptional. It appears that Compaq attempted to write more helpful manuals, but sometimes the wording and imagery are clumsy or difficult to follow.

The new manuals are bound in book form so it is not possible to add inserts or revisions as was the case with three-ring binders. Compaq has also done away with the IBM-style slipcovers. The advantage of the new manuals is that they are slightly easier to handle than the comparable IBM manuals.

Quick-reference cards are included with all three manuals. The *Operations Guide* card includes the following topics: system reset, key-click volume adjust, print-screen procedure, installation of fixed-disk partitions, changing the logged disk drive, keyboard layout, and use of special function keys. The MS-DOS card includes batch commands, configuration commands, all utility commands and options, display options, and graphics commands. The BASIC quick-reference guide includes all BASIC commands and options.

Compaq's reference cards are much more informative than the IBM DOS

(continued)

AT A GLANCE

Name
The Compaq Plus

Manufacturer
Compaq Computer Corporation
20333 FM 149
Houston, TX 77070
(713) 370-7040

Components
Size: width 20 inches, depth 15.3 inches, height 8.5 inches
Weight: 28 pounds
Processor: Intel 8088 16-/8-bit microprocessor and socket for addition of the 8087 math coprocessor

Memory
128K bytes of RAM, expandable to 256K bytes on the processor board, expandable to 640K bytes with an add-on card

Display
9-inch high-resolution video display; 25 lines by 80 characters; IBM PC-compatible high-resolution graphics with RGB color monitor connection; adjustable viewing angle; composite video connector; optional RF modulator

Keyboard
detachable 83-key IBM PC-compatible layout on a 6-foot coiled cord, adjustable typing angle

Storage
360K-byte double-sided 5¼-inch floppy-disk drive; 10-megabyte fixed disk

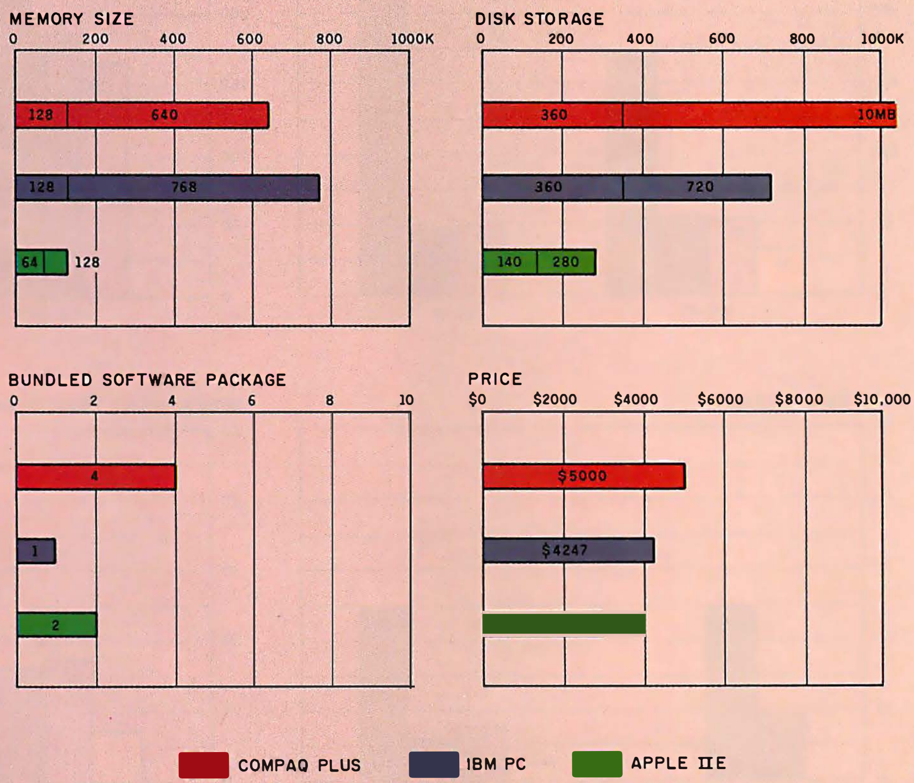
Expansion
Two IBM PC-compatible expansion slots; parallel printer interface included

Software
MS-DOS 2.02 and Microsoft BASIC 2.0 included; FDISK fixed-disk management utility and diagnostics; MS-LINK linker program; runs most IBM PC-compatible programs

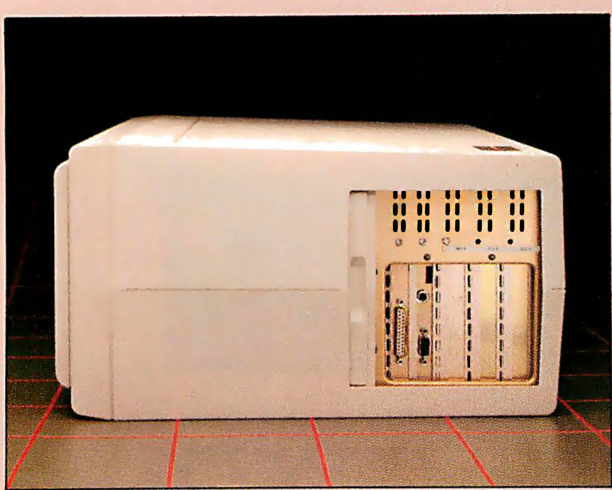
Price
$4995 for the basic system with 128K bytes of RAM, one floppy disk, and the 10-megabyte fixed disk

Warranty
90-day limited

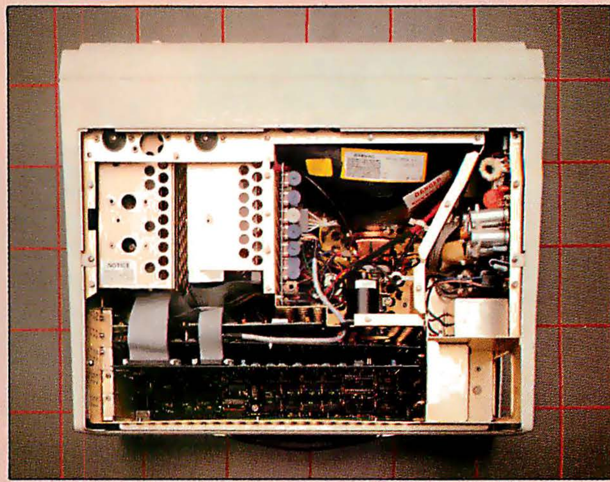




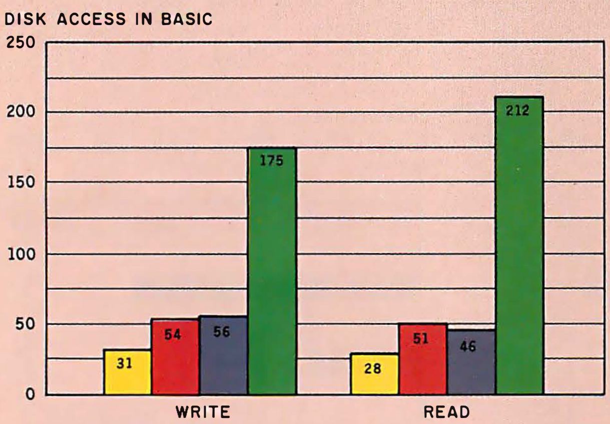
The Memory graph shows the standard and optional memory available for the computers under comparison. The graph of disk storage capacity shows the highest capacity of a single floppy-disk drive for each system. For the Compaq Plus, the 10-megabyte fixed-disk storage capacity also is shown. The bundled software packages graph shows the number of software packages included with each system. The price graph shows the Compaq Plus list price compared to systems with two high-capacity floppy-disk drives, a monochrome monitor, graphics and color-display capability, a printer port and a serial port, 256K bytes of memory (64K bytes for 8-bit systems), the standard operating system for each system, and the standard BASIC interpreter for each system. For details of the Compaq Plus specifications, see the configuration details in the At a Glance listing.

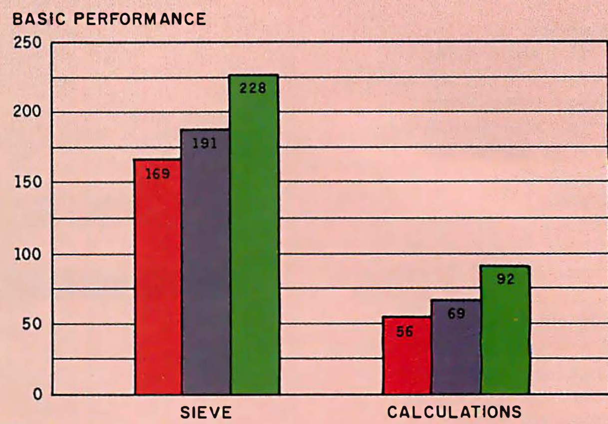


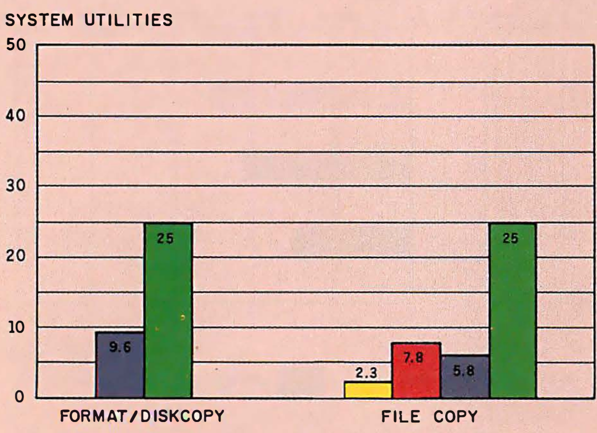
Sliding panel on right side covers serial port, video connectors, and three blank expansion slots.

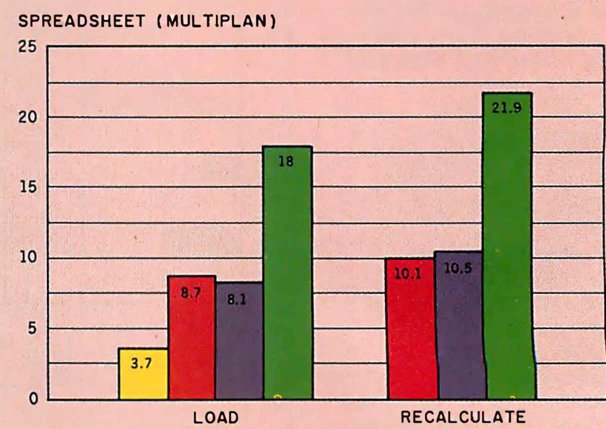


Top view reveals fixed disk (upper left), with floppy disk to its right. Power supply is at right, expansion slots at bottom.









FIXED DISK   FLOPPY DISK   IBM PC   APPLE IIE

The graphs for disk access in BASIC show how long it takes to write a 64K-byte sequential text file to a blank floppy disk and how long it takes to read this file. (For the program listings see "The Chameleon Plus," by Rich Krajewski, June BYTE, page 327) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The calculation graph shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers. The system utilities graphs show how long it took to format and copy a disk (adjusted time for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The spreadsheet graph shows how long the computers took to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The spreadsheet program used was Microsoft's MultiPlan.

These performance graphs include both floppy- and fixed-disk results where applicable. A format/disk-copy test was not performed on the Compaq Plus's single floppy-disk drive because the test is designed for a two-drive system.

REVIEW: COMPAQ

The company claims that the Compaq Plus can be dropped off a tabletop and will not be harmed.

reference card that simply lists the DOS commands and options without explaining what the options are for. The only misleading material I could find was in the *Operations Guide* card where the MS-DOS keyboard was listed as allowing the use of the PgUp, PgDn, Up, Down, Home, and other keys that MS-DOS does not respond to. These keys can only be used in BASIC or other programs, but the MS-DOS command mode does not make use of them. EDLIN, the MS-DOS line-oriented text editor, does use some of these keys, but the quick-reference guide doesn't make this clear and a first-time user easily could be confused.

TRANSPORTABILITY

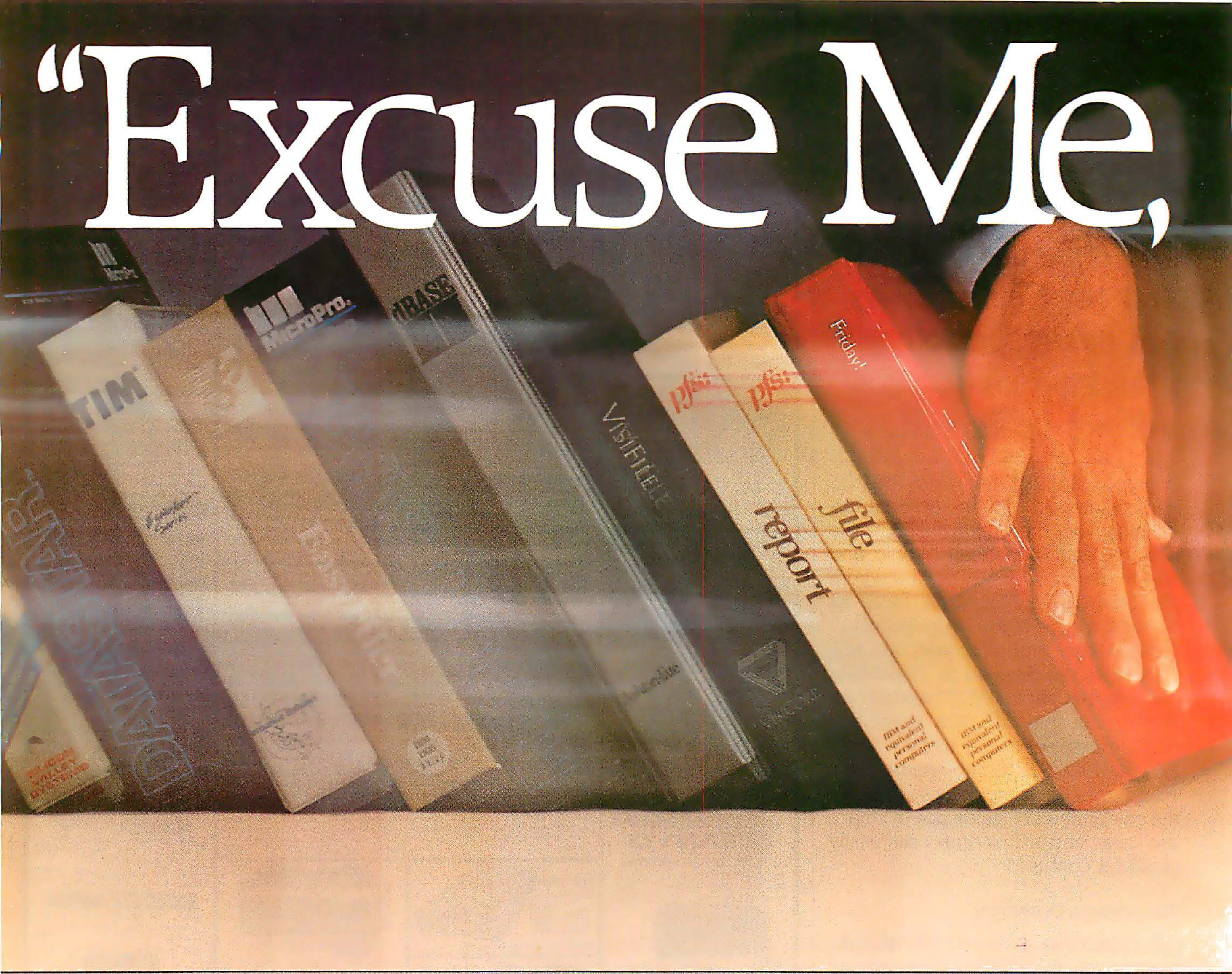
Can a fixed disk stand up to the punishment of transportability? Compaq has gone to great lengths to make certain that the fixed disk will not receive any severe shocks while being moved from place to place. The company claims that the computer can be dropped off a tabletop and will not be harmed. While I didn't perform this drastic test of its claims, I did format the fixed disk and carry the unit around with me, giving it what I thought would be average treatment in daily life. Because a friend of mine owns a standard Compaq and I have borrowed it from time to time to work on software for him, I had a pretty good idea of what the Compaq Plus fixed disk should be able to withstand in normal use. Every test of the fixed disk (using the included diagnostic program) has shown no damaged sectors or lost information. Unless you plan to use the Compaq Plus while on an African safari, it should live up to its manufacturer's claims.

IN CONCLUSION

The Compaq Plus is an excellent transportable computer and its fixed disk operates reliably under normal conditions in daily life. ■

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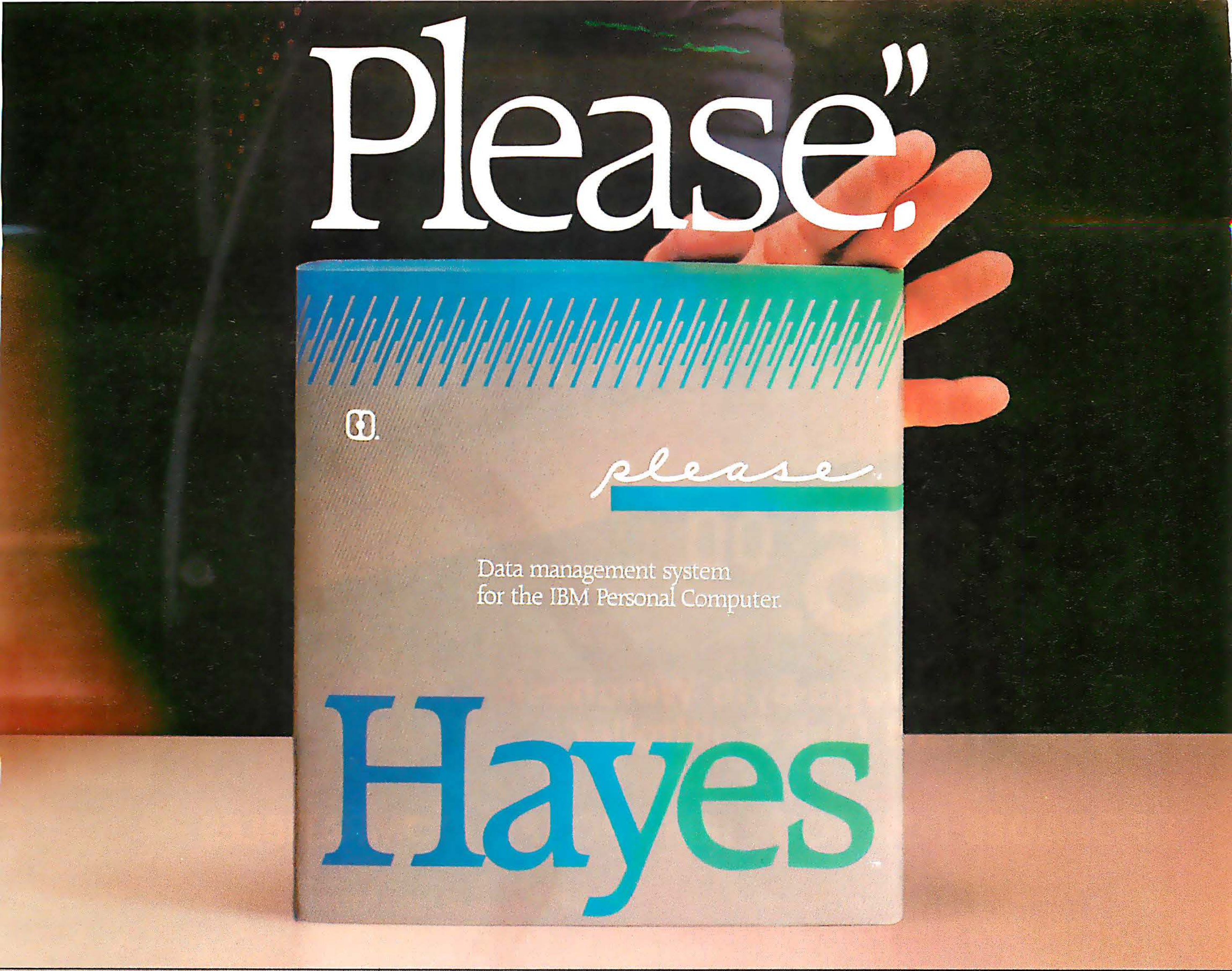
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Design a special screen format to position data in a particular place.

knowing all that storage power is there? Just in case you ever need it?

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XENIX *for the* IBM PC XT

Sritek's 68000-based XENIX system

BY STEVEN H. BARRY AND RANDALL JACOBSON

Is Sritek hardware in an IBM chassis really a supersystem? The Sritek Company is a small firm from Cleveland, Ohio, that manufacturers an add-in memory/microprocessor card for the IBM PC. Its advertisements claim that this add-in card provides the ultimate in performance for the price.

In this review we will look at Sritek's 68000-based multiuser XENIX system for the IBM PC XT. This consists of Sritek's VersaCard (256K bytes of memory) equipped with an extra 256K bytes of memory and Sritek's 68000 MicroCard. As for software, we will look at Microsoft's complete XENIX system, including the Software Development package, the Text Processing package, and the Multi-User package. The complete system we tested costs $2995. A basic single-user system with only 256K bytes of memory is available for $1995.

We will discuss how an early sample of this system worked, compare it with the Radio Shack and Fortune versions of UNIX that we have reviewed, and discuss the advantages and disadvantages of the three-way IBM-Sritek-Microsoft marriage on an IBM PC XT. First, let's point out that the add-ins being tested here are really used best in an IBM PC XT hard-disk system, not in the standard PC. The manuals get very conservative about using XENIX on a floppy-only configuration. The system is a fantastic performer, but, in the XENIX software version 2.3A, released in July 1983, it is definitely not one for UNIX novices.

Sritek's implementation of XENIX, and the 68000 coprocessor to run it, is based on a software-partitioned hard disk. This partition allows PC-DOS (the IBM operating system) and XENIX to coexist on the same device. Limited data-file interchange is available now, but more is promised in the future—along with an MS-DOS (the generic version of PC-DOS) emulator for XENIX. When this becomes available, the user's investment in IBM-style software will be compatible with the XENIX/68000 purchase. Now, however, there is no such compatibility.

HARDWARE INSTALLATION

The Sritek hardware is based on a Motorola 68000 processor running at 8 MHz. The processor card, or MicroCard, is mounted on a Sritek VersaCard that has 256K bytes of dual-ported memory, a connector for an additional piggyback 256K-byte memory board, and a connector for the proprietary SRIBUS. The SRIBUS connector is used to interface one of the several Sritek MicroCard processor boards (e.g., National 16032, Zilog Z80, Intel 80286, Intel 8086).

Sritek assumes you have 128K bytes, 192K bytes, or a full 256K bytes of memory mounted on the IBM PC XT motherboard. In the current version of the IBM motherboard, any memory over 256K bytes must be located on expansion boards in the IBM chassis. All of this expansion-board memory must be disabled to use the Sritek memory. This is a disadvantage for owners who have multifunction boards that also supply inexpensive memory. On the other hand, Sritek's memory is available for use by PC-DOS if you set the IBM motherboard switches to reflect the total amount of memory in the system (IBM plus Sritek). We did not test this aspect of the Sritek hardware. Another disadvantage, according to Sritek, is that the IBM power-up memory diagnostics will take a long time to run through the extra memory. The hardware we tested was a complete 68000 system that implemented 512K bytes of Sritek memory (in a 128K-byte IBM chassis). The 68000 processor uses Sritek memory when it is installed and in control of the system (running XENIX or one of the other operating systems offered by Sritek). Sritek says it may be used by the IBM PC XT's 8088 processor as an expansion memory for PC-DOS when the 68000 is not in control of the system. In the dual-processor mode, the 68000 runs its operating system (e.g., Microsoft's XENIX, the University of

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AT A GLANCE

Name
Sritek VersaCard/MicroCard

Manufacturer
Sritek
10230 Brecksville Rd.
Cleveland, OH 44141
(216) 526-9433

Price
Single user, $1995
Multiuser, $2995

Processor
Motorola 68000

Memory
256K bytes expandable to 512K

Hardware Needed
IBM PC XT

Software Supplied
Microsoft XENIX

Audience
Knowledgeable end users

California at San Diego's pseudocode p-System, Digital Research's CP/M-68K, and Ryan-McFarland's RM/COS while the XT's 8088 processor is used as an I/O (input/output) processor and the IBM memory is used as an I/O buffer.

The Sritek memory is based on 64K-byte chips and is ported to allow access by either the 8088 or the 68000 processor under control of the XENIX operating system by means of an arbitration scheme. The 68000 has a paged memory-management hardware system that allows access to 2 megabytes (MB) of physical memory and supports program relocation. Relocation is essential to a multiuser, multitask operating system such as XENIX. It allows programs and data to be mapped into the available chunks of physical memory.

The alternative (placing programs at predetermined contiguous places) would cause excessive program-execution delays. A program that had to be loaded at location *x* and was 8400 bytes long, for example, would have to wait until location *x* and the next 8399 bytes were vacated. Even if the first program were transferred to disk periodically, the heavy disk I/O would cause unacceptably low performance during "simultaneous" program runs.

All of this is avoided with a memory-management capability. The Sritek memory-management hardware allocates memory in 1K-byte chunks and allows processes (i.e., programs) to be as big as 512K bytes.

Because Sritek's XENIX operating system (OS) and PC-DOS coexist in separate disk partitions, both are available to the user. A future XENIX release will reportedly allow you to execute a PC-DOS program on the IBM 8088 processor under XENIX. Sritek XENIX software also allows the console terminal to be used as a three-way split-screen terminal.

Based on their performance and our visual inspection, the Sritek boards we tested were all well designed and executed. However, they were early releases and did not include the usual metal mounting bracket found on IBM-compatible hardware, nor was a card-guide included. Thus, the heavy, two-board-thick assembled unit was held in the IBM bus by the mechanical properties of the bus connector alone—a "bad show." We called Sritek to confirm that current shipments include these necessary accessories. Due to the double thickness of the complete Sritek assembly, you need two empty adjacent card slots to install it. The XT has more space than the PC, so this requirement is not as bad as it might have been, even though card slots are very scarce commodities in the IBM chassis. You hate to lose one whole slot due to bulky cards. The hardware installation was

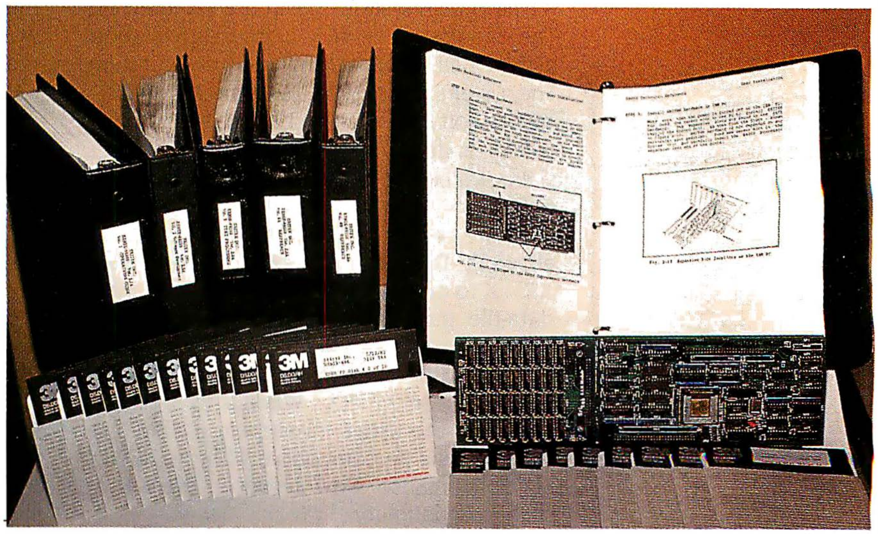


Photo 1: *Sritek's 68000-based multiuser* XENIX *system for the* IBM PC XT *with* Versa-Card, *extra memory, and* MicroCard, *and system software for development, text processing, and multiuser support.*

easy and the documentation was fairly complete, although it was plagued by idiosyncratic writing and devoid of formatting features that could ease the installer's job.

The hardware installation was the easiest part of the Sritek test. The card was preassembled and the switches were preset at the factory. We rearranged the cards already on the IBM bus to make room for the slot wasted by the double-thick Sritek module. We then cannibalized another IBM PC for a double-sided floppy drive. The one supplied by IBM was only a single-sided drive and Sritek supplies the software on 20 double-sided disks. Still, things went well and the machine booted quite serenely after the major surgery.

Cold Start

The first steps after the actual installation of the hardware are to verify that the hardware is not interfering with the IBM PC XT and that the Sritek board actually works. The first of these is done by booting the IBM in PC-DOS (version 2.0) in the usual manner. That is, a PC-DOS floppy disk is inserted in the drive, or the floppy-disk drive door is left open so that the ROM (read-only memory) defaults to the 10-MB hard disk (if it has been formatted and PC-DOS installed). The monitor (an IBM color unit in this case) is turned ON and then the main power of the XT is turned ON. The usual lengthy wait ensues while the boot ROMs lead the machine through the memory check and hardware diagnostic routines. Finally, the OS comes up.

On this "loaner" system, the color/graphics adapter was being handled as a 40-column device due, probably, to the presence of IBM's medium-resolution color monitor. Sritek's XENIX handles the screen as an 80-column device, and PC-DOS must preset this mode before XENIX is started. Thus, after power-up in PC-DOS and the usual date and time entries, the proper thing to do is type "mode 80 <return>". This causes the system to handle the video-display terminal as an 80-column device (pretty uncomfortable on this type of color video-display terminal). The 80-column mode also can be set as a power-up default setting. Sritek explicitly recommends the 80-column switch setting on the IBM motherboard for in-

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VAX VMS				
VAX UNIX (4.1 BSD)				
PDP-11 UNIX (V6, V7, III)				
IDRIS/R11				
RT–11				
RSX–11M/M+				
MC68000 UNIX (UNIPLUS+)				
IDRIS/S68K				
MS/PCDOS				
CP/M–86				

HOST ONLY: CP/M–80*, CP/M–68K, VERSAdos, P/OS–11 (*2.1 Cross Compilers are Available)

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It is visually interesting, like modern art, but not much like anything you've seen before.

stallations with the color graphics card, but it is easy to miss this recommendation in the current manuals.

After a successful PC-DOS boot, the Sritek "BRINGUP" floppy is exchanged for the PC-DOS disk and the SRITEST diagnostic is run. Everything ran fine in our case, and the manual said to skip the sections on installation for other manufacturers' hard-disk configurations.

The OS Configuration Procedures section of the technical manual occupies about 13 pages out of 130 (less appendixes). The following ominous note appears at the end of the first page: ". . .You should be willing to follow the directions carefully. *Note: Follow the step-by-step procedure given in the next several pages to avoid mistakes. Do not skip any steps as it will result in an improper XENIX configuration.*" The whole process (hardware, software, and disk surgery) took about three hours. The procedure looked simple: insert a couple of disk partitions, follow a detailed example, and then let the Sritek batch file (really a "shell script") do the rest. First, a copy is made of the Sritek BRINGUP disk. Then the PC-DOS partition is removed from the hard disk if it had been installed previously (a backup is made of the current hard disk contents before the partition is removed). You are asked to decide on the amount of space on the hard disk to be allocated for XENIX (at least 7 MB) and whether you want a DOS partition. We chose 8 MB for XENIX and 2 MB for PC-DOS.

When you think about it, a 10-MB disk is pretty small—at least for a UNIX system. UNIX is large. The "kernel" is usually between 60K bytes and 128K bytes, and the utilities, on-line manuals, games, useful programs, required system files, and commands take several megabytes of disk space. Its size is the result of it being a very powerful operating system and also the consequence of having about 200 very useful utility programs in a completely developed system. Other operating systems are smaller, but the consequences become obvious when a common UNIX-style facility is needed and not available. Thus, we have doubts about using a 10-MB disk for even one OS, let alone two, when one of them is UNIX.

ANTICIPATE

The SRIFDISK utility on the BRINGUP disk was used to install the two disk partitions we chose. This was where I should have noted the instruction to jot down the number of sectors for XENIX. Because the instruction appears as part of the example, or perhaps because we were having an off night and didn't read the screen message completely, we didn't record the number. This wasn't a disaster—just a little uncomfortable until we decided what to do to recover. Otherwise, partitioning the disk was not difficult.

At step 5 of the instructions, things begin to get interesting. The "BOOTABLE" program is run from the BRINGUP disk. This installs a bootstrap loader in the Sritek memory for use by the 68000. Then BRINGUP is typed. Here was where the number of sectors (blocks) was needed. The instruction manual does not warn you that you will be asked for this information at this point. After calculating the theoretically correct answer and entering edit, a long series of commands was executed in a batch-type environment. The result is that the XENIX kernel, bootstrap, swapper, and a portion of the "root" file system were installed within the 8-MB XENIX partition on the hard disk. Following this step, you are instructed to insert each of nine disks that contain the rest of the files to be installed in the "root" (i.e., the XENIX system's) file system.

UNIX allows disk media to be divided into several named sections, called file systems. Sritek's implementation of XENIX uses two of these—the system's information is put in the root file system, while the user's information is put into a user-file system. An unexpected question is displayed at this point: "/dev/usr contains data. Overwrite? (y/n)"—the documentation has no guidance for you (the question is not even mentioned in the documentation). We guessed "y" on the grounds that we were doing a new thing on top of the PC-DOS data. We got lucky—the system picked up on the prepared script shown in the manual. After the nine "root" TAR (tape archive) disks are fed in, you are asked to feed the 10 user-file TAR disks to the system. Loading disks takes about 55 minutes (think about the implications of this for making backups of the hard disk). After this is done, you are finally ready to log into XENIX.

BRINGING UP, BACKING UP, AND BACKING OUT

The backup copy of the BRINGUP disk is inserted in the floppy-disk drive, the IBM software Reset key-sequence is pressed (Ctrl-Alt-Del) and then the XT uses the AUTOEXEC.BAT file on the disk to execute the sequence of commands that invokes XENIX. All goes well—unless you have expanded on the Sritek instructions as we had. We decided not to set the hardware switches to indicate 80-column mode for the color monitor. Reading 80-column text is uncomfortable for us on a medium-resolution color monitor. We were given no modal choice by the XENIX OS since it only provides an 80-column terminal handler that thinks it is talking to a Televideo 925 terminal. Nevertheless, we wanted 40-column displays in PC-DOS (40-column displays have other disadvantages). Thus, when we executed the IBM software Reset key-sequence, the display was automatically reset to 40-column mode as indicated by the hardware switches. The software, however, was expecting 80-column mode. So, while the XENIX bootstrap procedure went along just as planned, we found ourselves looking at an unreadable display. We were victims of our own attempt to preserve our display options. Forty-column hardware and a Televideo handler program yield an interesting pattern of unreadable dots repeated, more or less, in each of the four quadrants on the screen. It is visually interesting, like modern art, but not much like anything you've seen before. The solution was to return to PC-DOS and reset the 80-column mode.

However, we first had to get into XENIX to shut it down in an orderly way. UNIX users learn quickly that one does not just turn off a UNIX machine. The result, often, is a corrupted file system.

(continued)

No UNIX *novice should attempt to learn the* XENIX *system while logged in as the superuser.*

Now, this was not likely since the system was, according to the Sritek manual, at a log-in message. However, this was a new system and was installed with a manual already shown to have a few quirks. We were not happy about possibly losing several hours' work. Some people would think of this as a potential adventure. We just thought of it as a lot of potential messing around. There are no instructions of any worth in the installation manual on how to log into XENIX. You are told to do so, period.

A careful reading of three separate portions of the Microsoft XENIX manuals may tip you off, but maybe not if you're a XENIX novice. So the problem was, "How do we log into XENIX and provide for an orderly shutdown when we can't see what the system's doing?" Well, we "lucked out" again. Reasoning that XENIX should be standard across machines, we used the same startup and shutdown sequences as in the Radio Shack TRS-80 model 16B XENIX review we wrote last summer. Voilà! We were back in control without major consequences. However, we don't recommend this as a general practice. For one thing, randomly pressing keys in a UNIX system is a lot like looking into a strange tank of fluid with a match for light. In some cases nothing happens. In others, the results are quite explosive. In this case, however, all we had to do was type Ctrl-D (to allow the system to start up in "normal" mode—really multiuser mode), enter the date and time in YYMMDDHHMM format, and type "root" (the system managers' account) in response to the invisible "login:" invitation. Then, after the system invisibly gave us the "superuser" command prompt (a "#"), we typed "haltsys" to run the program that brought things to an orderly stop. This is another area where Sritek should have provided an explicit set of instructions. Even a careful reading of the Sritek and Microsoft XENIX manuals does not yield a clear, concise explanation, in one place, of how to start the system from "cold," how to log in for the first time, and how to establish less dangerous accounts than "root." The system is, as it comes from Sritek, easiest to log in on as "root." Root is, of course, the superuser (manager), who can read and write any file, can use any available command, and is responsible for system maintenance. No UNIX novice should attempt to learn the system while logged in as the superuser. In extreme cases, whole file systems can be lost irretrievably or critical system files or utilities can be damaged beyond use. In less drastic cases, files can be made inaccessible to regular system users.

Again, the problem is that the manuals are not very clear about getting into XENIX. In fact, the manuals don't even explain that typing <RETURN> at the first log-in prompt activates XENIX in single-user mode. Having made it into multiuser XENIX through information gleaned from another manufacturer's product, our next step was to shut it down so we could decide what to do about the display. We typed "haltsys" and halted the system.

Having extricated ourself from the 40-column syndrome, we created a small AUTOEXEC.BAT file to set mode 80 and boot into XENIX. Our AUTOEXEC.BAT does this by using the XENIX.EXE utility provided on the BRINGUP disk. This strategy avoids the Ctrl-Alt-Del sequence that, in PC-DOS, resets the screen to 40-column mode and began all the trouble we just described. The procedure works well and the normal XENIX start-up screens are seen during the boot process. From there on, it is fairly normal XENIX. A lot of commands and programs that are extra with other companies' XENIX systems (e.g., Radio Shack) are included with Sritek's implementation at a cost of $495 for the software. These include the C language, a host of development utilities, and the usual multiuser capabilities (although you supply your own hardware I/O ports). The software is all there to support a heavy development environment. It's just that the documentation is not up to the job.

Sritek reports that a number of flaws reported in this review have been corrected since we received our unit last summer.

First, the IBM can have more than 256K bytes of RAM (random-access read/write memory). But Sritek recommends that when you first bring up the XENIX system, you remove all but the first 256K bytes of memory. When the XENIX system is running correctly, you supposedly can replace your expansion memory boards up to 512K bytes of memory. A 64K-byte "widow" starting at 9000 hexadecimal must be left open to allow the 8088 to access the memory on the 68000 board.

Documentation

Technical manuals have been the neglected stepchildren of the microcomputer industry. Sritek's manuals (including Microsoft's manuals) are actually examples of high quality, compared with most put out by the industry. In particular, the manuals are full of such advice as: "Ground yourself thoroughly before you touch any component on the board. (CAUTION: The MOS IC [metal-oxide semiconductor integrated circuits] components on the board are sensitive to static discharge. Static can damage MOS ICs.)" However, better organization is needed. The caution should have appeared before the instruction to unpack the boards. Complete instructions on ways to ground yourself safely should have followed. Then, and only then, should the user be instructed to unpack the boards. All of these should have been set off from installation instructions by clear document formatting conventions.

Warnings (possibility of injury), cautions (possibility of equipment damage), and notes (things to watch out for to assure proper installation) should each be formatted in a distinctive style. Doing so would draw the user's eye before attempting an improper action. The Sritek technical reference manual constantly refers to the IBM DOS manual for required details of procedures (e.g., making backup files before installing the XENIX software). Such actions, even if they are PC-DOS actions, should be explicitly described in the Sritek manual in each of the places where the material is relevant. Similarly, the manuals should not refer to earlier sections for instructions. Sritek illustrations are placed near their text references, but the quality of reproduction and the use of photos instead of drawings make them nearly

useless. In the sections on software installation, the manual fails to adequately distinguish between what is placed on the screen by the computer and what is required of the installer.

Cautions and notes (not labeled as such) routinely come after the text describing the action they are meant to modify. A few cautionary messages appear on the screen buried in text, rather than in the manuals. Screen formatting of information and instructions that belong in cautionary messages is lacking. For example, at one place in the installation instructions you are asked (in a long message on the screen) to record the number of disk blocks available to XENIX. This number is used later. The message is easy to miss. We missed it and it cost us several minutes of reading and calculation to reconstruct the number that we should have recorded.

Finally, the installation manual fails to follow an actual live installation sequence. There are several places where unexpected questions appear, where the sequence of events is not quite as stated in the manual, or where a full explanation of the range of possible user actions is missing. There are other places where known bugs in the IBM PC-DOS software should have been explained and the way to fix them presented. These comments on the Sritek manual cover only some of the issues that make a manual easy or hard, helpful or not. The point is that, while it is certainly possible to use much of the available documentation, a lot can be done to make it easier and faster (without necessarily shortchanging the user on valuable technical detail). The benefit to the user is less chance of dangerous, costly, or annoying foul-ups. We can all do with fewer of those.

The XENIX manuals are similar to the standard AT&T documents supplied by Western Electric in their version 7 release of UNIX, with some additional material to cover enhancements. A few changes, mostly cosmetic, have been made. The documents are fine for an experienced UNIX user but terrible for a newcomer. Commands and programs are documented in a peculiarly terse and unnecessarily technical style guaranteed to confuse even experienced users of other systems. UNIX hackers who begrudge every extra character in a document love this stuff. In fairness, Sritek told us that the system is intended for use by system houses and by knowledgeable end users, and that the manuals were not the best and most current because, just as it was about to spend a bundle to typeset the real stuff, AT&T announced that the new System V manuals, which were to be available soon, would be great. We find it hard to have much patience with this when a bunch of users are getting some pretty raw stuff until "soon" rolls around.

Sritek has indicated that it has also upgraded the documentation since our review. It has added several addenda on such topics as how to log on to XENIX, how to access printers, and so forth. Information on the major device number has also been added to the manual.

LEGACY

UNIX is a great operating system, but it is hard to learn on your own without some good tutorial manuals. UNIX development began at a time (in the 1960s) when the only inexpensive and reliable terminal around was the Teletype model 33. This device was slow (10 characters per second) and the keys required several pounds of pressure to actuate. Thus, the user-system interaction is extremely terse. Users wanted to type as few characters as possible and were just as happy to have the result of a command be blissful silence. We are left with that legacy in the standard user interface for UNIX, the one Microsoft uses in this version of the OS (Sritek says that the Microsoft "visual shell" is not far off). We think a company should compensate by including one of the three good commercially available introductions to UNIX in its $500 software package when its own introductory material is unsatisfactory.

A more serious omission, however, was that the copy of XENIX we reviewed was undeveloped. Even Microsoft's (nontutorial) manuals were inaccurate in several critical details. Several important files for UNIX are placed in atypical (for UNIX) parts of the file system, while the manual calmly quotes AT&T chapter and verse on where they should be. The line-printer (serial or parallel) driver is not configured, and the usual UNIX-style procedures won't work. This, in turn, is due to insufficient information in the Sritek technical manual (the major device number is missing) about the oddly named or misplaced files. These are all indications that Microsoft rushed XENIX out the door. We hope that the long-awaited XENIX version 3.0 will arrive from Microsoft and most of these criticisms will be answered. Note that the Radio Shack version of XENIX we tested several months ago was much cleaner, much better documented, and much easier (still not easy) for a new UNIX user to grasp. All without waiting for AT&T's System V manuals. Also, this Microsoft XENIX was missing many

(continued)

Table 1: *The machine tested had a 512K-byte memory and an 8-MHz 68000 chip. Each test was run twice, with the lowest time recorded. Entries in the Real column represent total elapsed time; entries in the User column represent time in the user process; and entries in the System column represent kernel time. Times are given in seconds.*

Function	Command	Real	User	Sys
compile sieve	cc -0 sieve.c -o sieve	27.0	3.3	5.4
execute sieve	sieve	1.0	0.5	0.1
simultaneous sieves	sieve&sieve&sieve&time sieve	1.0	0.5	0.1
compile terminal	cc -O terminal.c -o terminal	29.0	3.9	5.4
one terminal	terminal 1	19.0	0.4	5.0
two terminals	terminal 2			
three terminals	terminal 3			
compile disk	cc -O disk.c -o disk	30.0	4.0	5.6
one file	disk 1	2.0	1.2	0.3
two files	disk 2	5.0	2.3	0.6
four files	disk 4	12.0	4.9	1.1
eight files	disk 8	18.0	11.1	2.3
simultaneous sorts	sort f1 >f1s&sort f2>f2s&sort f3>f3s&time sort f4>f4s	41.0	4.7	1.7
multifile sort	sort f1 f2 f3 f4 > sorted. file	67.0	24.5	9.1

Truly knowledgeable end users will have a fine time with the add-in memory and processor cards.

mature XENIX niceties. Installing a new user is a matter of editing several files as "root" instead of running a simple utility and typing the new user's name and password. Several other utilities that make life easier were also missing.

PERFORMANCE

Whatever Sritek lacks in glossy presentation, good manuals, and mature XENIX implementation, it is certainly not lacking in system performance. This system is clearly the fastest number-crunching UNIX-style microcomputer implementation we have ever tested. The MC68000 chip was only running at 8 MHz (10 MHz is a planned option) on our board, yet the benchmark times we found were outstanding. Other UNIX or XENIX systems using 6-MHz 68000s (e.g., Radio Shack TRS-80 model 16B and the Fortune 32:16 System 20—not an XP model) were several hundred percent slower on the sieve.c compute-bound benchmark reviewed in the Gilbreath and Gilbreath article and the Barry and Jacobson article (see references). These other systems are not particularly slow (they're right about where you would expect them to be, given their clock speed)—the Sritek is just very quick. The benchmark is shown in table 1. This is the same benchmark we used for the Radio Shack test. The compile time is longer for the Radio Shack (33 seconds) than for the Sritek (27 seconds), while the Fortune compiled sieve.c fastest of all (20 seconds). These long compile times occur because the process is primarily disk-bound. All three systems have relatively slow stepper-motor-type Winchester disks (average access time about 90 milliseconds or so). Note, however, that the Sritek and the Radio Shack both have separate I/O processors with their buffer memory (a Z80 and 64K bytes in Radio Shack's), but both require more compile time than the Fortune. On execution time for the benchmark program called Sieve of Eratosthenes, a compute-bound algorithm for finding 1899 prime numbers (see references), the Sritek used only one-tenth the time needed by the Radio Shack and did nearly as well against the Fortune. When four simultaneous sieves were executed, the execution time for the last one was the same as for a single sieve. The Radio Shack performance was nearly proportional (380 percent longer). The results are so good that we wonder if the XENIX time utility was really working (although the other times—compile, terminal I/O, disk, and sort—were also quick, but reasonable). In fact, two other sieve benchmarks we've seen, from other sources using Sritek hardware and XENIX software, have very different (and longer) execution times. According to our figures, the Sritek evidently uses the 8088 and its memory to good advantage in I/O-intensive situations but really shines in compute-bound tasks. This conclusion is valid for all of the diverse times that have been reported for the sieve benchmark on this product.

CONCLUSIONS

The Sritek add-in board provides a high-performance boost for the IBM PC XT in XENIX. The documentation is relatively poor, even in the realm of relatively poor UNIX documentation. Sritek does not have a national distribution or dealer network—all repair work is on a return-to-factory basis, and the installed base is not large. The full 512K-byte Sritek system will cost $2,995 over what's already invested in the IBM PC XT system. All that money (about $9,000 total) for a nearly raw system and the disadvantages of a multivendor maintenance situation is a little too much. For that kind of money, there are several good vendors out there with fine systems that are fully supported by both dealers and a national service organization. True, these systems are much slower at compute-bound tasks, but they often match, or exceed, Sritek's abilities on typical I/O-intensive business tasks.

We were not able to test any of the application program library mentioned in the technical reference manual. It is worth noting, however, that some good UNIX application software is on the market (usually bundled with or available on a major manufacturer's hardware package) and that more will be out soon. Sritek mentions the usual business standards—a spreadsheet, a word processor, a database manager, a full accounting system, etc.—in its technical reference manual's specifications list. These packages seem to be drawn from those available in the general UNIX/XENIX market. It is not clear what level of support a business user would have from Sritek on such third-party software. Our guess is that if a bug cropped up you would go to the software vendor and hope that it was not due to some subtle interaction between the IBM hardware, the Sritek hardware, the Microsoft OS, and your application package. Sritek's intended market—advanced users and systems houses—should be able to handle these problems, but not quickly nor easily.

In summary, we can recommend the Sritek add-in memory and MC68000 processor cards as outstanding technical products. Truly knowledgeable end users will have a fine time with this hardware. The XENIX software and documentation can be expected to improve substantially in the near future; in fact, since our review Sritek has started offering Pascal and C compilers and the Unify database-manager program. Once some other hurdles are jumped (with little help from the current documentation), the operating environment is comfortably UNIX, version 7, with the Microsoft enhancements described in our Radio Shack article (see references). The product may gain broader appeal with better documentation, more mature OS software, easily available applications software with integrated support on the Sritek system, a strong dealer network, and national support. Sritek reports that the System V version of UNIX will be available this summer, along with a board based on the 68010 chip with enhanced memory-management capabilities. ■

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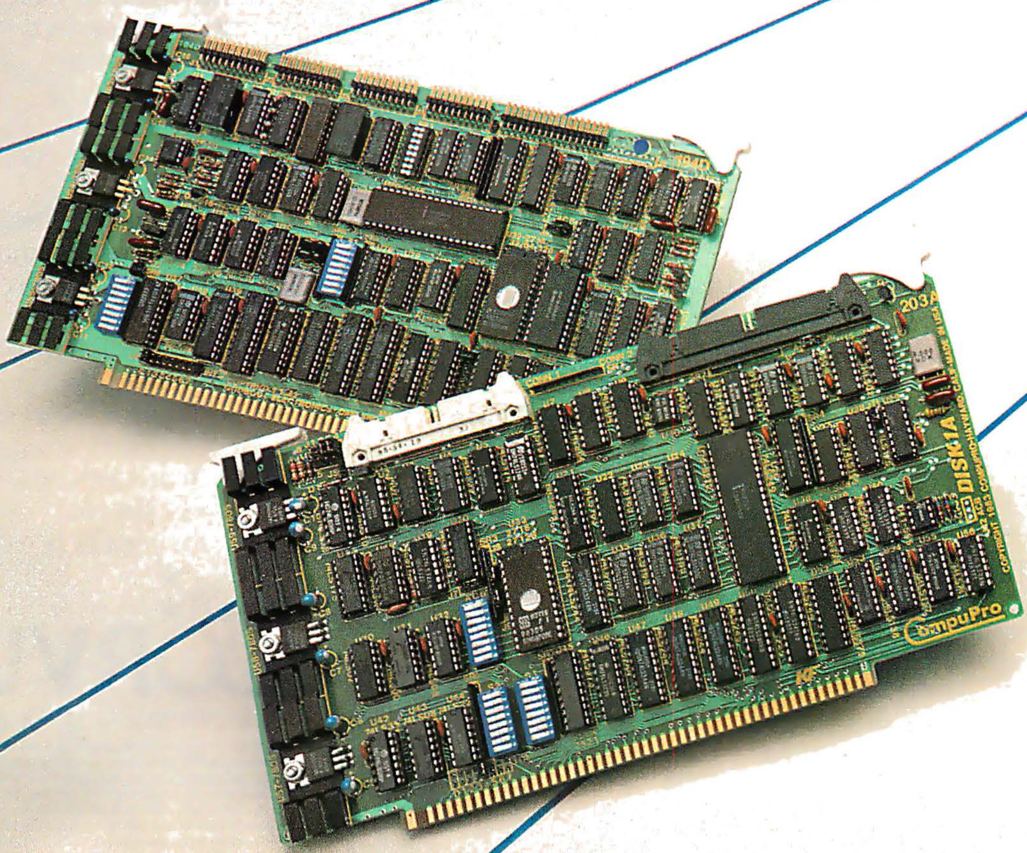
THE ESSENTIALS

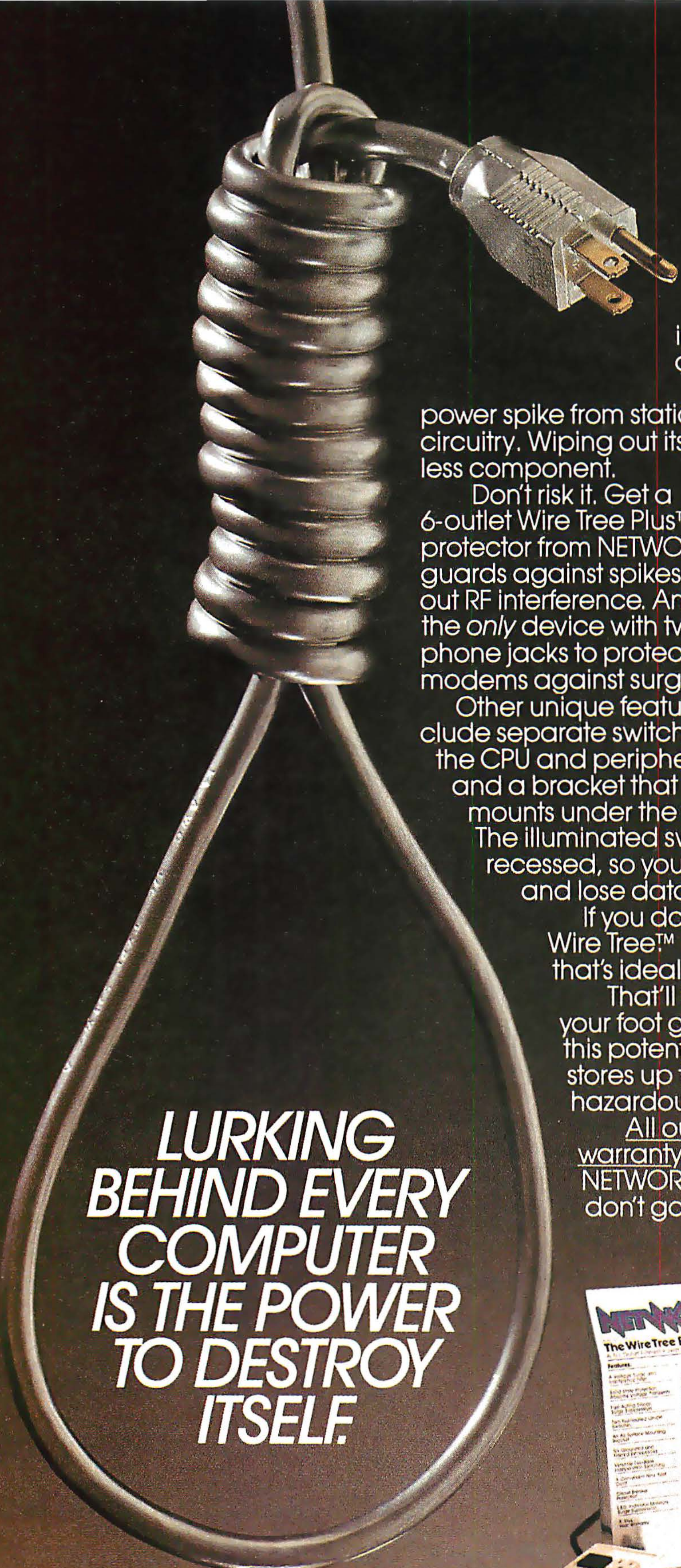
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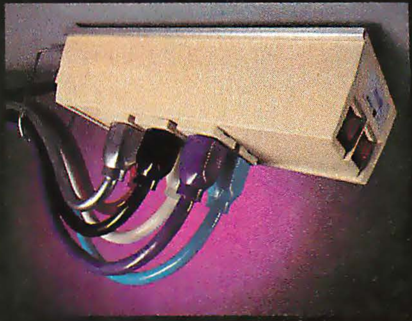
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Turbo Pascal

A high-performance, low-cost compiler

BY TOM WADLOW

Borland International's Turbo Pascal is a new language compiler that claims to combine the benefits of structured programming in Pascal, the interactive convenience of an interpreted language like BASIC, and the speed of a compiled language. All this is included in a package that retails for an amazingly low $49.95.

Since Pascal is a compiled language, using it on a personal computer usually means you spend a lot of time cycling between compiler and editor, often shuffling disks in the process. What Borland International has done, however, is provide a souped-up compiler and a programming environment to use it in. The result is a high-level language that can be used for some kinds of serious program development but is easy and fast enough to be used for writing small applications as well. In other words, you shouldn't throw away that BASIC disk, but it will probably gather a lot of dust between uses.

In this review, I'll examine both versions of Turbo Pascal (CP/M and PC-DOS), describe its major features, and compare it to other "professional" compilers. (See also the text boxes "Turbo Pascal on CP/M" on page 268 and "Turbo Pascal on the IBM PC" on page 270.)

The Environment

When you begin to run Turbo Pascal, the Turbo Main Menu comes up. From the menu you can select the files you will work with and the fashion in which they will be handled, and you can view some information about the resources at your disposal. Entering a single letter will execute one of the menu commands, but each menu item is displayed as a word or phrase, with the key letter highlighted on the screen.

From this menu you can edit or compile a program, change working drives, view a directory of the disk (or a subset of that directory), or change the parameters of compilation.

The Editor

Turbo comes equipped with a built-in screen editor that is helpful when making small changes in a program. As supplied by Borland, the Turbo editor commands resemble a subset of the WordStar word processor's command set. However, the editor can be configured during installation to look like, more or less, a wide variety of popular editors. I successfully configured the Turbo editor to accept a Mince-like set of commands, but it took several tries to get everything to behave properly.

This editor is very convenient. Errors occurring during program compilation automatically will put you back into the editing mode, with the cursor positioned on the line of code that caused the error. When you are executing a program that has been compiled into memory, some run-time errors such as a divide-by-0 will also drop you into the editor. This makes changing and recompiling fairly effortless compared to the traditional way of developing code on small systems.

The Turbo editor is not suitable for massive amounts of editing. There are several activities where the editor's inefficiencies will outweigh its convenience, and you will probably need to use another utility program. One example is the FIND and REPLACE functions, used for string substitution. A number of options are available to restrict or extend the type of searching and replacement that is done. However, for each iteration of the search, the program appears to start from the beginning of the file. This means that the replacement of each occurrence of a common string will take a long time.

Another strange feature of this editor is the definition of tabs. Most text editors have fixed or definable tab stops across a line. Many people are accustomed to formatting source code by indenting lines with the Tab key. The tabs in Turbo are a bit of a surprise, though. Tabs are set anew on each new line. This is done by automatically placing a tab stop at the start of each and every word on the previous line. Thus, a tab just after a carriage return will align the next line with the start of the previous line. There is some sense to this method, but I

(continued)

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Turbo Pascal on CP/M

BY AL PIERCE

Turbo Pascal allows in-line machine code and supports the full range of CP/M BDOS and BIOS functions as well as allowing user-written I/O drivers. Interrupts may be used but the programmer is responsible for preserving any registers used by the interrupt routines. Care must be taken because the standard I/O operations used by Turbo routines are not reentrant. This means that they will not work properly when called from within an interrupt handler. Likewise, the BDOS functions and most BIOS calls cannot be used. Interrupt enable and disable may be handled by the use of in-line statements.

In addition to the information on these features, the manual also contains system memory-management information. This includes memory maps of the system during the various compile and execute phases as well as the HEAP and STACKs. The operating-system specifics are covered in a thorough and concise manner with the programmer in mind. Examples pertaining to the use of each feature are given, many of which are short procedures that may be used as learning tools. I wouldn't have minded a bit more detail in some areas, such as the EXECUTE function, but on the whole I found it to be a good piece of documentation.

I found Turbo Pascal for CP/M to be an excellent product. The user interface is well done and the inclusion of terminal control functions is a nice touch. The ability to invoke other COM files from the main menu removes the tedium of switching back and forth to the operating system to copy files or check the directory. I only wish the Control-P printer toggle had been left intact but one can't have everything. Borland International deserves praise for this high-value product.

Al Pierce (POB 2755, Livermore, CA 94550) is an electronics technologist at the Lawrence Livermore National Laboratories.

found that the tabs did not do what I wanted more often than they did. There is, unfortunately, no way to perform traditional tab alignment.

The editor has several other features that may be a help or a hindrance to you, such as the software toggle for auto-indent and insert/overwrite, but the use of these is more a matter of personal choice than anything else. The fact that there is a convenient editor outweighs the small errors or design oversights that it may contain.

THE COMPILER

The compiler can be directed to compile directly into memory, where the program can then be executed, or you may compile onto the disk. The memory option is fast and useful for development. Compiling onto disk can be done in one of two ways. An executable file (i.e., a COM file under MS-DOS) can be created, which can then be run directly from the operating system. You can also create special chain files (CHN), which are used only by Turbo programs and will be explained later.

The Turbo compiler is fast, but slightly peculiar. Turbo is not exactly the Jensen and Wirth definition of Pascal. If you are a Pascal purist, you may be irritated by the differences, especially if you bought it to run "standard" Pascal. But permit me a brief editorial comment: There is no such thing as standard Pascal. Yes, lots of people advertise that they sell it. I know about the Jensen and Wirth book that supposedly defines it. But standard Pascal doesn't really exist, because real Jensen and Wirth Pascal is not worth much as a programming language. It was never intended to be a development language, just a teaching tool. The real measure of Pascal compatibility is the similarity of dialects. For example, almost every Pascal worth using has defined a default clause for the CASE statement. This is not in the standard. When you compare

You can compile directly into memory, where the program can then be executed, or you can compile onto the disk.

Turbo Pascal to other versions of the language, you should examine Borland's extensions to the language and see if they are similar to your favorite version of Pascal.

I would describe Turbo as a Pascal-like language. The basic structure of Pascal is present, but in those places where changes are usually made, namely the CASE default clause, strings, I/O (input/output), structured constants, etc., the variations on a theme are often striking. Turbo is not really Pascal. But it's very useful.

DATA STRUCTURE

Turbo has all the standard types: integer, real, Boolean, and char. An integer is a 16-bit signed number. There are no long integer or unsigned integer types. There are also several new basic types:

- byte—essentially an 8-bit, unsigned integer
- strings—yet another implementation of strings in Pascal. These are done pretty well, though. A string is declared with its maximum length. Thus a string[80] can be less than or equal to 80 characters in length. A string[1] is essentially equivalent to type char.

There are also a whole slew of built-in routines to deal with strings such as:

DELETE—delete a substring
INSERT—insert a substring
STR—convert integer to string
VAL—convert string to integer or real
COPY—return a substring
CONCAT—concatenate two strings
LENGTH—determine string length
POS—search for a substring

In addition, adding strings can be done with the plus (+), which is the same as CONCAT.

Turbo also allows enumerated types, as in other Pascals. The difference in

Turbo comes with predefined data structures that enable you to perform the equivalent of BASIC's PEEK *and* POKE.

them lies with their I/O. In J&W Pascal, the code:

```
program test(output);

var
  foo: (alpha, beta, gamma);
begin
foo:=beta;
writeln(output,foo);
end.
```

should cause the text "BETA" to be written through output. In Turbo, this causes a compile error.

A new twist in Pascal data structures is the Turbo typed constant. This is a means of creating constants of any previously defined type, including arrays, strings, and records, even variant records. This capability is often found in more advanced programming languages than Pascal, and it is often useful. A typed constant might look like the one in listing 1. In this fashion, specialCommands becomes a read-only variable of type commandTable. Because you can do this for essentially any type, there are many possibilities for saving time and code-space initializing data structures.

Turbo comes with predefined data structures that map onto memory and I/O ports, so that you can perform the equivalent of BASIC's PEEK and POKE if you are so inclined. This is sometimes described as "being able to feel the bits between your toes."

FILE I/O

Borland has overhauled file I/O for Turbo Pascal. The way a file is referenced is by means of a file variable. The first operation on any file variable must be an ASSIGN, which binds the DOS name for a file to that file variable. Other operations that are only performed on file variables are:

(continued)

A Second Opinion

Comments on Turbo Pascal

BY MARK BRIDGER

Since purchasing Turbo Pascal several weeks ago I have put it through its paces intensively: writing new programs and transferring old ones developed using Microsoft Pascal. I am teaching Pascal at Northeastern University this quarter and I write frequent illustrative programs to hand out to my students. It is truly a pleasure to create them using the Turbo editor and compile them to check for errors. What used to take several minutes of whirring disk drives now takes a few seconds; executable code files of 20K to 30K bytes are now reduced to 10K to 12K bytes. With this kind of performance, the difference in convenience between a compiled and an interpreted language is virtually nil.

In addition to schoolwork, I have developed several long scientific graphics programs. One of these, a surface drawing package, is about 2000 lines of source code. Making even minor changes in this program has hitherto been a time-consuming activity—even with 300K bytes of RAM disk. Thus, I was particularly anxious to see if it could be adapted to Turbo easily.

The first change was the graphics procedures: these were originally written in Pascal and assembly language and linked to the main body of the program. I first tried to use Turbo's "external" directive to call the machine-language routines. Unfortunately, this didn't work. The documentation of external procedure calls in the manual is confusing and contains several obvious errors. I tried many different rewrites of my assembly code to access the variables and return to Pascal: all to no avail. I could, it seems, call the routine, but I couldn't get back.

Finally I gave up and called Borland International for help. I eventually spoke to Mr. Phillippe Kahn, the president of the company. He discouraged me from trying this link-up and suggested that I either use the INLINE method of accessing machine code or, better yet, do the graphics interrupts directly by using the INTR procedure. This procedure turned out to be ideal. You simply create a record REGISTERS (whose fields are the names of the 8088 registers), assign values to the appropriate fields, and then call INT(num, REGISTERS) where num is the number interrupt desired. It works like a charm, completely eliminating the entire machine-language linking.

Turbo does have a few quirks that require getting used to. For one, the input is not buffered the way that I'm used to in other Pascals. You can't look ahead by accessing INPUT^. EOLN works a bit differently; you can't use IF NOT EOLN READLN(x) ELSE READLN to skip over a read with a return. However, you can get around this quite elegantly by reading input into a string and using the powerful string-handling routines. One of these, VAL, converts a string of digits into a real or integer—handy for bullet-proofing I/O. Also, strings are limited to 256 characters; it would be nice to have a full 64K bytes to use the string handling for large-scale byte manipulation.

Turbo has some truly wonderful memory-accessing tools such as the MEM array (all of memory becomes an array of bytes), the SEG and OFS functions, and the PTR function that allows you to create a pointer to any (absolute) memory address. If Turbo became the standard we might not have to program in C to play games.

Turbo is, without doubt, the best software value I have ever purchased. And, for the whipped cream on top, the latest version of Turbo contains access to all of the IBM PC's graphics modes, a line-drawing algorithm, multiple windowing, sound, and, for a small amount extra, 8087 support.

Mark Bridger (21 Champa St., Newton Upper Falls, MA 22164) is an associate professor of mathematics at Northeastern University in Boston, Massachusetts.

REWRITE—open a file for writing
RESET—open a file for reading
READ—read a component of the file
WRITE—write a component to the file
SEEK—move to a location in file
FLUSH—update the file
CLOSE—stop using a file
ERASE—erase a file from disk
RENAME—give the file a different name
EOF—detect end of file
FILEPOS—return position in file
FILESIZE—return size of file

In addition, there are the usual variations for text files, such as READLN, WRITELN, and EOLN.

Conspicuously absent are the Pascal GET and PUT functions. Borland has eliminated them from Turbo, and for good reason, as I know of no other concept (with the possible exception of pointers) in Pascal that has caused as much classroom confusion as GET and PUT. The Turbo READ and WRITE routines are sufficient to deal with the problems that GET and PUT were intended to solve.

LANGUAGE OPERATIONS

The first thing I look for in a new implementation of Pascal is the CASE statement. As I have said before, the default clause (i.e., the statement that is executed when the selector of the CASE does not match any of the explicitly defined clauses) is a useful thing to have in a language. But there seem to be as many ways of implementing a default clause as there are designers of versions of Pascal. Borland has created yet another way—one that I don't care for much. An example of the Turbo CASE statement from the Turbo manual is shown in listing 2.

Notice that there is no BEGIN-END block surrounding the statements after the ELSE. Also notice that a semicolon precedes the ELSE. These irregularities are without precedent in the rest of the Pascal grammar. I think that Borland tried to make a CASE-ELSE that resembled the IF-THEN-ELSE statement. Unfortunately, what the company has done is create a statement that does not follow the grammatical conventions of the rest of Pascal.

This is not to complain that the ELSE is bad because it is nonstandard. My complaint is that the grammar of CASE-ELSE has a different flavor from anything else in Pascal. Turbo's typed constants are not standard, but they follow from the way types, variables, and constants are defined. This is a violation of standards but not a violation of spirit. The way the ELSE is defined for the CASE is a violation of both.

PROCEDURES AND FUNCTIONS

Pascal is known as a strongly typed language, which means that the compiler tries hard to assure that the user declares exactly what kind of object each variable and parameter is and then enforces those decisions all the way through the program. Thus, if you declare a variable to be of type REAL, you cannot assign to it an INTEGER value.

Sometimes it is necessary to convert between types, however, and the standard Pascal solution has been to "wire-in" several conversion functions to the compiler and hope that they cover all possible cases. Examples of these converters might be FLOAT, which converts INTEGER to REAL, and TRUNC, which converts REAL to INTEGER.

In standard Pascal, it is not possible, save by exploiting holes in the language definition, to write your own FLOAT or TRUNC. They are "magic" routines provided by the author of the compiler. In Turbo, however, you can write conversion routines. Borland has provided a set of extensions to Pascal that allow you to relax type checking in a structured way. This permits you to do, in a consistent fashion, many of those things that Pascal programmers have been doing for years, by "cheating."

For example, imagine writing a routine to concatenate two strings. Ideally, it

Listing 1: *An example of a typed constant.*

```
type
  commandTable = array [1..5] of string[8]
const
  specialCommands: commandTable =
    ('RUN', 'STOP', 'LIST', 'COMPILE', 'QUIT');
```

Listing 2: *An example of the Turbo CASE statement from the Turbo manual.*

```
case Year of
  Min..1939: begin
               Time := PreWorldWar2;
               write('The world at peace..');
             end;
  1946..Max: begin
               Time := PostWorldWar2;
               write('Building a new world.');
             end;
else
  Time := WorldWar2;
  write('We are at war');
end;
```

Turbo Pascal on the IBM PC

With one small exception, the differences between Turbo on the IBM PC and Turbo on CP/M are all improvements. Most of the problems encountered with the CP/M version of Turbo have been corrected on the IBM PC version. There does not seem to be any difference between the execution of a program that has been compiled into memory and a program compiled into a COM file. There are a few restrictions, however. For example, it is not possible to use the CHAIN and EXECUTE routines from a memory-compiled program. These restrictions are well documented.

The editor on the IBM PC version of Turbo comes preinstalled, so little configuration is necessary. You must choose the display mode that the program will run (monochrome or one of the color display modes). If you wish, the installation program can be used to reconfigure the editor commands to taste.

The one missing feature in IBM Turbo is the EXECUTE command. The Turbo Main Menu lists a command that is advertised to execute a COM file directly. Unfortunately, this option has not yet been implemented for PC-DOS, as a message tells you when you try it.

AT A GLANCE

Name
Turbo Pascal

Use
Pascal compiler and development environment for MS-DOS and CP/M-80

Manufacturer
Borland International
4807 Scotts Valley Dr.
Scotts Valley, CA 95066

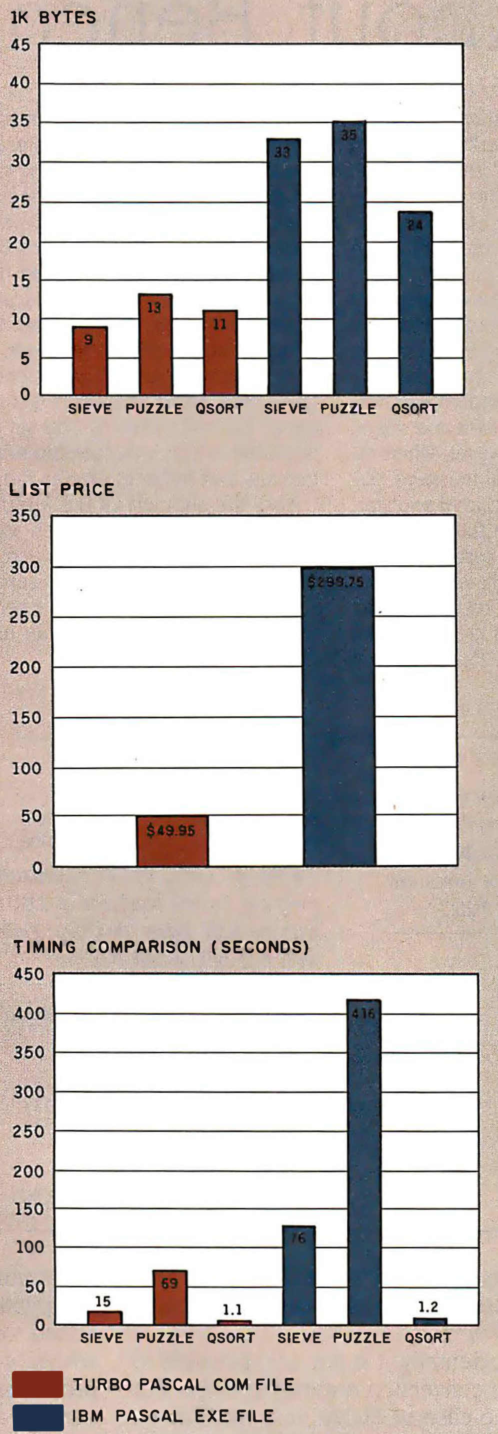
Size
Compiler and editor take approximately 35K bytes on MS-DOS

Features
Built-in screen editor and fast compilation to memory or disk; many language additions and special routines for performing systems programming

Documentation
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Price
$49.95

Comments
A good development environment for small applications; similar to, but better than BASIC for many programs; not very compatible with other Pascal compilers



A comparison of Turbo Pascal and IBM Pascal running under PC-DOS on the IBM PC. Three programs, the Sieve, Puzzle, and Qsort (listings 3-5), are compared in terms of program size (top) and execution time (bottom). See the text box entitled "A Word About Benchmarks" for further details.

A Word About Benchmarks

The comparison of any two compilers is a tricky thing. There are many variables and no one benchmarking program can cover all the bases. In addition, there are some intangibles, such as the convenience of use or the presence or absence of certain features, that may make one compiler "better" than another, even though the benchmarks may say otherwise.

Some notes on methodology: When making the measurements whose results are shown here, Al Pierce and I tried to measure what was important and discount what was not. For example, the measurements of compile speed were made from the issuing of the COMPILE command until the command prompt was displayed again. Thus, when compiling to COM files, the speed of the disk drives was an important factor. However, when executing a COM file, we measured from an initial message, discounting the time it took the operating system to load and start the program. The reasoning behind this was that the interesting part of the execution was the algorithm being tested and not the operating-system load routine. In addition, all measurements were done at least three times and the listed results are the average of those three (or more) runs. All times greater than 2 seconds are rounded to the nearest half-second. The results are shown in tables 1 and 2.

Compile times for IBM Pascal are not shown because the method of compilation was so drastically different (involving two separate programs and a linking phase to produce an executable program) that it would have been meaningless to try and compute a time for this process. Suffice to say that, in all cases, the process ran to several minutes for any of the three programs. In addition, it should be noted that IBM Pascal produces EXE files, a format that is slower to load and considerably larger, but more flexible, for large address space programs.

Two of the programs, Sieve (see listing 3) and Puzzle (see listing 4), are fairly well known as benchmarks for compilers. The third, Qsort (see listing 5), performs a Quick Sort on a worst-case array of 100 real numbers. This set of benchmarks is certainly not intended to fully measure the difference in performance for all features, but rather to give an indication of overall performance.

Also, the anomaly of the Puzzle benchmark, whose compile to a COM file is shorter (even with disk I/O) than a compile to memory, is not a mistake but actual measured performance. We did it eight times just to be sure.

Finally, just for the sake of a general comparison, a version of the Sieve benchmark was run under IBM BASICA. It took 33 minutes to complete.

Table 1: *Benchmark results for Turbo Pascal running under* PC-DOS 2.0. *The benchmark programs were compiled on an* IBM PC *with* 320K *bytes of memory and two double-sided double-density disk drives. Compilation and execute times are shown in seconds; file sizes are to the nearest* 1K *byte.*

Time for:	Sieve	Puzzle	Qsort
Turbo Pascal			
Compile to memory	0.8	5.7	3.4
Compile to COMFILE	2.0	3.6	4.0
Execute in memory	15.0	69.0	1.3
Execute COM file	15.0	69.0	1.1
IBM Pascal			
Execute EXE file	76.0	416.0	1.2
File Sizes:			
Turbo COM file	9,000	13,000	11,000
IBM EXE file	33,000	35,000	24,000

Table 2: *Turbo Pascal benchmark results for* CP/M 2.2. *The computer system used had a* Z80A *processor running at* 4 *Mhz with no wait states, and two double-density* 8-*inch disk drives with a* 3 *millisecond step rate.*

Time for:	Sieve	Puzzle	Qsort
Compile to memory	0.5	3.0	2.0
Compile to COM FILE	5.0	12.0	9.0
Execute in memory	23.0	77.0	1.0
Execute COM file	25.0	77.0	1.0
File sizes:			
COM	8,000	12,000	10,000

should work just as well for two strings of type string[5] as for two of type string[80]. In standard Pascal you would need to write a separate routine for each size of string used. In Turbo, you could easily write one routine to handle all of them.

There are dangers in doing this, though. There is no way of limiting type independence to a certain set of types. Thus, some unpredictable things could happen if you pass the wrong things to a type-independent routine. Relaxation of type checking is not the default case in Turbo, so casual errors will probably be detected.

Incidentally, it is not only possible to write conversion routines in Turbo, but in the case of FLOAT, it is mandatory. Turbo comes equipped with a TRUNC, but not a FLOAT. Thus, there is no built-in way of converting integers to reals.

External Routines

One important feature that Turbo lacks is the ability to create libraries of external routines. This facility of separate compilation allows you to build a storehouse of procedures and functions whose code can be shared by many programs. In addition, the ability to compile and test portions of a program separately helps to speed up the development cycle of new applications.

Because Turbo compiles directly into executable files and no external linking is done, it is not possible to separately compile modules from a single applica-

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Listing 3: *The Sieve of Eratosthenes prime-number program. It originally appeared in "Eratosthenes Revisited: Once More through the Sieve," by Jim Gilbreath and Gary Gilbreath, January 1983 BYTE, page 283.*

```
const
  size = 8190;
var
  flags : array [0..size] of boolean;
  i,prime,k,count,iter : integer;
begin
writeln('10 iterations.');
for iter:= 1 to 10 do
  begin
  count := 0;
  for i := 0 to size do
    flags[i] := true;
  for i := 0 to size do
    if flags[i] then
      begin
      prime := i + i + 3;
      (* writeln(prime); *)
      k := i + prime;
      while k <= size do
        begin
        flags[k] := false;
        k := k + prime;
        end;
      count := count + 1;
      end;
  end;
writeln(count, ' primes.');
end.
```

Listing 4: *The Puzzle program, written by Forest Baskett, solves a simple puzzle.*

```
program puzzle;
(* A compute-bound program from Forest Baskett *)
(* This program solves a simple puzzle, and has been run on a very
    wide variety of machines *)

const
  size      = 511;
  classMax = 3;
  typeMax  = 12;
  d         = 8;
type
  pieceClass  = 0..classMax;
  pieceType   = 0..typeMax;
  position    = 0..size;
var
  pieceCount   : array [pieceClass] of 0..13;
  class        : array [pieceType] of pieceClass;
  pieceMax     : array [pieceType] of position;
  puzzle       : array [position] of boolean;
  p            : array [pieceType, position] of boolean;
  m,n          : position;
  i,j,k        : 0..13;
  kount        : integer;
function fit (i : pieceType; j : position) : boolean;
label 1;
var
  k: position;
begin fit := false; for k := 0 to pieceMax[i] do
  if p[i,k] then if puzzle[j+k] then goto 1;
fit := true;
1:
end;
function place (i : pieceType; j : position) : position;
label 1;
var
  k: position;
begin
  for k := 0 to pieceMax[i] do
    if p[i,k] then puzzle[j+k] := true;
  pieceCount[class[i]] := pieceCount[class[i]]-1;
  for k := j to size do
    if not puzzle[k] then begin
      place := k;
      goto 1;
    end;
  writeln('Puzzle filled.');
  place := 0;
1:
end;
procedure remove (i : pieceType; j : position);
var k : position;
begin
  for k := 0 to pieceMax[i] do
    if p[i,k] then puzzle[j+k] := false;
  pieceCount[class[i]] := pieceCount[class[i]] + 1;
end;
function trial (j : position) : boolean;
label 1;
var
  i : pieceType;
  k : position;
begin
  for i := 0 to typeMax do
    if pieceCount[class[i]] <> 0 then
      if fit (i, j) then begin
        k := place (i, j);
        if trial(k) or (k = 0) then begin
          writeln ('Piece ', i+1, ' at ', k+1);
          trial := true;
          goto 1;
        end else remove (i, j);
      end;
  trial := false;
1: kount := kount + 1;
end;
begin
  writeln('Beginning PUZZLE');
  for m := 0 to size do puzzle[m] := true;
  for i := 1 to 5 do for j := 1 to 5 do for k := 1 to 5 do
    puzzle[i+d*(j+d*k)] := false;
  for i := 0 to typeMax do for m := 0 to size do p[i, m] := false;
  for i := 0 to 3 do for j := 0 to 1 do for k := 0 to 0 do
    p[0,i+d*(j+d*k)] := true;
  class[0] := 0;
  pieceMax[0] := 3+d*1+d*d*0;
  for i := 0 to 1 do for j := 0 to 0 do for k := 0 to 3 do
    p[1,i+d*(j+d*k)] := true;
  class[1] := 0;
  pieceMax[1] := 1+d*+d*d*3;
  for i := 0 to 0 do for j := 0 to 3 do for k := 0 to 1 do
    p[2,i+d*(j+d*k)] := true;
  class[2] := 0;
  pieceMax[2] := 0+d*3+d*d*1;
  for i := 0 to 1 do for j := 0 to 3 do for k := 0 to 0 do
    p[3,i+d*(j+d*k)] := true;
  class[3] := 0;
  pieceMax[3] := 1+d*3+d*d*0;
  for i := 0 to 3 do for j := 0 to 0 do for k := 0 to 1 do
    p[4,i+d*(j+d*k)] := true;
  class[4] := 0;
  pieceMax[4] := 3+d*0+d*d*1;
  for i := 0 to 0 do for j := 0 to 1 do for k := 0 to 3 do
    p[5,i+d*(j+d*k)] := true;
  class[5] := 0;
```

```
  pieceMax[5] := 0+d*1+d*d*3;
  for i := 0 to 2 do for j := 0 to 0 do for k := 0 to 0 do
    p[6,i+d*(j+d*k)] := true;
  class[6] := 1;
  pieceMax[6] := 2+d*0+d*d*0;
  for i := 0 to 0 do for j := 0 to 2 do for k := 0 to 0 do
    p[7,i+d*(j+d*k)] := true;
  class[7] := 1;
  pieceMax[7] := 0+d*2+d*d*0;
  for i := 0 to 0 do for j := 0 to 0 do for k := 0 to 2 do
    p[8,i+d*(j+d*k)] := true;
  class[8] := 1;
  pieceMax[8] := 0+d*0+d*d*2;
  for i := 0 to 1 do for j := 0 to 1 do for k := 0 to 0 do
    p[9,i+d*(j+d*k)] := true;
  class[9] := 2;
  pieceMax[9] := 1+d*1+d*d*0;
  for i := 0 to 1 do for j := 0 to 0 do for k := 0 to 1 do
    p[10,1+d*(j+d*k)] := true;
  class[10] := 2;
  pieceMax[10] := 1+d*0+d*d*1;
  for i := 0 to 0 do for j := 0 to 1 do for k := 0 to 1 do
    p[11,i+d*(j+d*k)] := true;
  class[11] := 2;
  pieceMax[11] := 0+d*1+d*d*1;
  for i := 0 to 1 do for j := 0 to 1 do for k := 0 to 1 do
    p[12,i+d*(j+d*k)] := true;
  class[12] := 3;
  pieceMax[12] := 1+d*1+d*d*1;
  pieceCount[0] := 13;
  pieceCount[1] := 3;
  pieceCount[2] := 1;
  pieceCount[3] := 1;
  m := i+d*(1+d*1);
  kount := 0;
  if fit(0, m) then n := place(0, m) else writeln('Error.');
  if trial(n) then writeln('Success in ', kount, ' trials.')
  else writeln('Failure.');
end.
```

Listing 5: *The QuickSort program sorts a numeric array.*

```
program QuickSort(input,output);
(* Sort a numeric array using a quicksort algorithm.
Adapted from volume 3, 'Art of Computer Programming' by D.Knuth *)
(* Several things have been done to this QuickSort to use it as
   a benchmark.
- The numbers to be sorted are REALS, which are a harder case than
  16-bit INTEGERS.
- The input array is hard-wired in. In TURBO this is done by using a
  typed constant. In the version used to benchmark IBM Pascal, the
  array is initialized at run-time. Since TURBO does not have an
  INTEGER to REAL conversion routine as IBM Pascal does, the two
  could not be coded identically. However, the benchmark clocking is
  done between the two -MARK-s, and initialization occurs before the
  first mark, so the difference due to Initialization methods should be
  minimal. The input array is the worst case reverse order.
- For the actual bench-mark, the body of printArray is commented out
  and replaced by a single writeln('-MARK-');. The reason for this is to
  permit more accurate measurements of the code speed rather than
  confuse the eye of the benchmarker. Benchmarks are taken between
  the MARKs, so as to exclude program loading times. *)
(* global identifiers *)
const
  max = 100;                        (* maximum array size *)
type
  standardArray = array [0..max] of real;
var
  numbers: standardArray;     (* array containing the numbers to be
sorted *)
  last: integer;
procedure swap(var a, b : real);
  (* Exchange the values of A and B *)
var
  t : real;                                   (* Temporary variable *)
begin
t := a;
a := b;
b := t;
end;
procedure printArray(top : integer);
  (* Display the current contents of the array *)
  (* Since this isn't the interesting part of the benchmark, this quick
     and dirty print routine take advantage of the 80 column screen
     with wraparound. Here is where you would put the more
     sophisticated output routine in a usable sort routine. *)
var
  i : integer;
begin
{for i := 0 to top              (* Commented out during benchmarks *)
do
  write(numbers[i]:8:2);
writeln;
writeln;}
writeln('-MARK-');                      (* Used during benchmarks *)
end;
procedure getArray(var top: integer);
  (* Fill array from input *)
  (* In a real sort program, this would get the array to be sorted from
     the standard input or a file or whatever. For the purposes of this
     benchmark, we will initialize the array with a predeclared array
     that is the worst case of a sort: an array in reverse order. Note
     the use of TURBO typed constants. *)
     const
       worstCase: standardArray =
       (100.0, 99.0, 98.0, 97.0, 96.0, 95.0, 94.0, 93.0, 92.0, 91.0,
         90.0, 89.0, 88.0, 87.0, 86.0, 85.0, 84.0, 83.0, 82.0, 81.0,
         80.0, 79.0, 78.0, 77.0, 76.0, 75.0, 74.0, 73.0, 72.0, 71.0,
         70.0, 69.0, 68.0, 67.0, 66.0, 65.0, 64.0, 63.0, 62.0, 61.0,
         60.0, 59.0, 58.0, 57.0, 56.0, 55.0, 54.0, 53.0, 52.0, 51.0,
         50.0, 49.0, 48.0, 47.0, 46.0, 45.0, 44.0, 43.0, 42.0, 41.0,
         40.0, 39.0, 38.0, 37.0, 36.0, 35.0, 34.0, 33.0, 32.0, 31.0,
         30.0, 29.0, 28.0, 27.0, 26.0, 25.0, 24.0, 23.0, 22.0, 21.0,
         20.0, 19.0, 18.0, 17.0, 16.0, 15.0, 14.0, 13.0, 12.0, 11.0,
         10.0,  9.0,  8.0,  7.0,  6.0,  5.0,  4.0,  3.0,  2.0,  1.0,
          0.0);
begin (* getArray *)
top := 100;
numbers := worstCase;
printArray(top);
end; (* getArray *)
procedure bubbleSort(start,top: integer; var subArray: standardArray);
  (* Bubblesort procedure, sorts array from start to top inclusive *)
var
  index: integer;
  switched: boolean; begin (* bubbleSort *) repeat
  begin
  switched := false;
  for index := start to top-1
  do
    begin
    if subArray[index] > subArray[index+1]
    then
      begin
      swap(subArray[index],subArray[index+1]);
      switched := true;
      end;
    end;
  end
until switched = false;
end;
```

(continued)

```
procedure findMedian(start,top: integer; var subArray: standardArray);
  (* Find a good median value in array and place it at beginnning of
     section to be sorted *)
var
  middle: integer;
  sorted: standardArray;
begin (* findMedian *)
middle := (start+top)div 2;
sorted[1] := subArray[start];
sorted[2] := subArray[top];
sorted[3] := subArray[middle];
bubbleSort(1,3,sorted);
if sorted[2] = subArray[middle]
then
  swap(subArray[start],subArray[middle])
else
  if sorted[2] = subArray[top]
  then
    swap(subArray[start],subArray[top]);
end; (* findMedian *)
procedure sortSection(start,top: integer);
  (* Sort a section of the main array, and then divide it into two
     partitions to be sorted *)
var
  swapUp: boolean;
  s,e,m: integer;
begin (* sortSection *)
if top-start < 6
then                          (* sort small sections with bubbleSort *)
  bubbleSort(start,top,numbers)
else
  begin
  findMedian(start,top,numbers);
  swapUp := true;
                                 (* start scanning from array top *)
  s := start;                    (* lower comparision limit *)
  e := top;                      (* upper comparision limit *)
  m := start;                    (* location of comparison value *)
  while e > s
  do
    begin
    if swapUp = true
    then                         (* scan downward from partition top *)
      begin                      (* and exchange if smaller than median *)
      while (numbers[e] >= numbers[m]) and (e > m)
      do
        e := e-1;
      if e > m
      then
        begin
        swap(numbers[e],numbers[m]);
        m := e;
        end;
      swapUp := false;
      end
    else                         (* scan upward from partition start *)
      begin                      (* and exchange if larger than median *)
      while (numbers[s] <= numbers[m]) and (s<m)
      do
        s := s+1;
      if s < m
      then
        begin
        swap(numbers[s],numbers[m]);
        m := s
        end;
      swapUp := true;
      end;
    end;
  sortSection(start,m-1);        (* sort lower half of partition *)
  sortSection(m+1,top);          (* sort upper half of partition *)
  end;
end; (* sortSection *)
begin                            (* QuickSort main program *)
getArray(last);
sortSection(0,last);
printArray(last)
end.                             (* QuickSort main program *)
```

tion. Borland has sacrificed separate compilation for speed of development, a trade that large applications developers won't care for, but I suspect that many casual users won't mind much.

There is a simple, fairly crude way of calling external routines, provided you know their address in memory, but it does not answer the problems raised above. Turbo provides two routines, EXECUTE and CHAIN, which can be used to run other p ograms.

EXECUTE will pass control to any program that you could run from the operating-system prompt. When that program terminates, control returns to the operating system, not the program that performed the EXECUTE.

CHAIN passes control to a specially compiled Turbo program. A normally compiled Turbo program contains the built-in Turbo library of standard routines. When you compile a chain program, this library is not included, making the code on disk a lot smaller. When a program is run through CHAIN, the library, which is already resident in memory, is kept but the application program is replaced by the chain program. When that program terminates, control returns to the operating system.

Turbo has a means of directly calling the operating-system service routines.

It is also possible to include external source files during compilation. By doing this, two programs could share the same source code, though not the same compiled code.

Other Turbo Features

Turbo contains a primitive facility for writing in-line machine code. The INLINE statement accepts a series of numbers and places them directly into the code being compiled. Using this feature it is possible to write interrupt handlers or optimize specific routines for speed. Again, this is a nonstandard but useful feature.

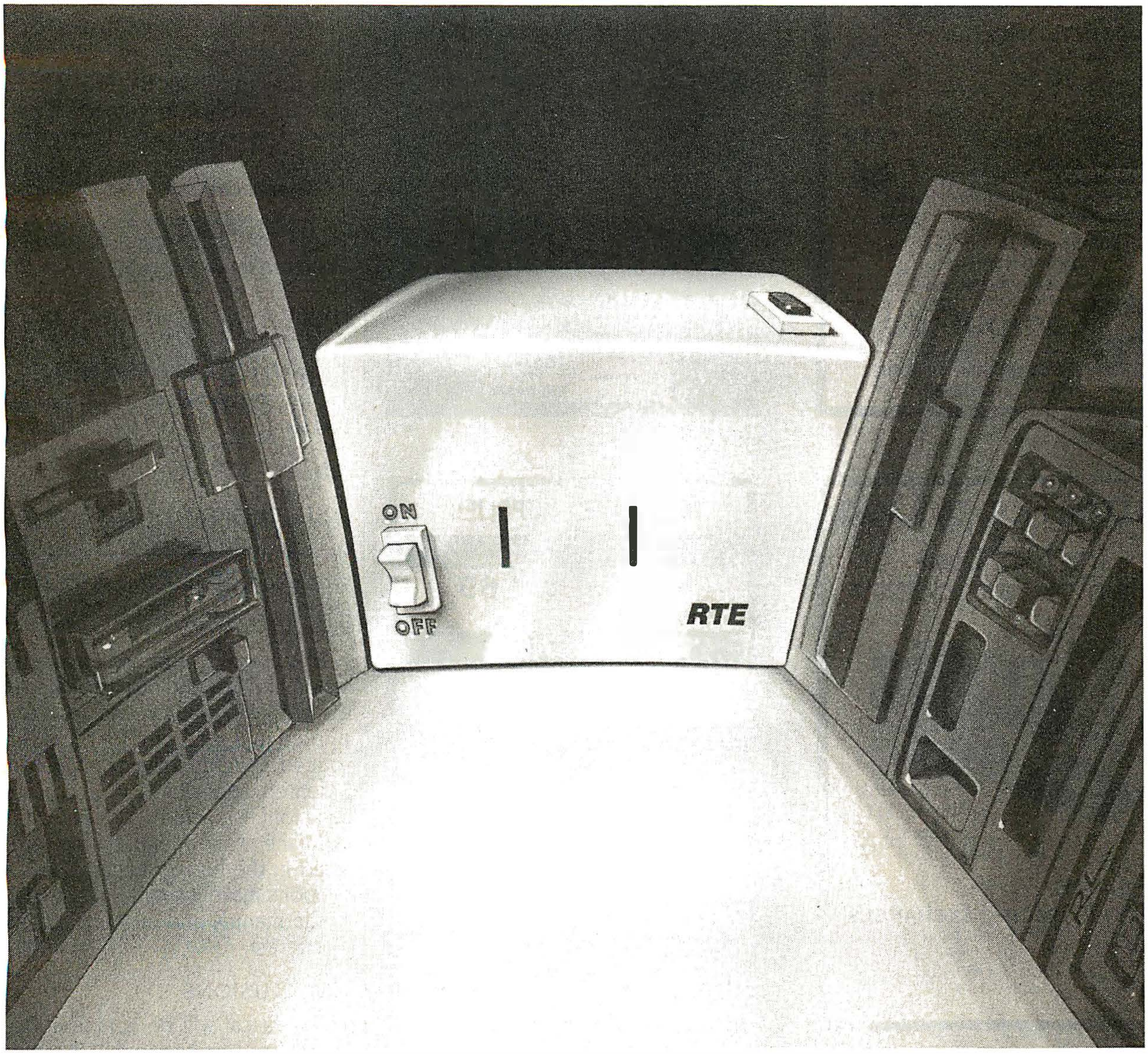
Turbo also comes equipped with a means of directly calling the operating-system service routines. This lets you write applications that can manipulate the environment provided by your operating system. A good example of this might be a directory listing program.

Documentation

Included in the Turbo package is a 254-page, softcover manual that is the documentation for Turbo Pascal. Almost everything that you might need to know about Turbo is in the manual, and I found it useful to run Turbo, compiling into memory, and then read the manual. Going through the book page by page,

(continued)

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it is easy to try out the examples while running Turbo or to write small test programs to see what a particular function does.

The manual is well written, as computer documentation goes. The first few pages have a flowchart of the manual structure and an explanation of the

Turbo is well written, fun to use at times, and fast enough to make up for its few shortcomings.

typography used. As far as I read, these standards were adhered to all the way through the book.

Typography is important in documentation and Borland has made good use of it in its manual. Normal text is printed in a sans serif font that is easy to read. Programming examples are all indented and shown in a typewriter-style font. Reserved words are shown in boldface, while identifiers are emphasized in the text by italics. These conventions make it simple to scan a page of the manual and pick out the points of interest.

Conclusions

Turbo Pascal will be compared to JRT Pascal and "professional" Pascal compilers. Both comparisons are somewhat unfair. Turbo most certainly is not a toy compiler, to be used until the real thing comes along. It is also not a good compiler for developing massive applications. (See the text box "A Second Opinion: Comments on Turbo Pascal" on page 269 for another author's estimation.) The real comparison that should be made is Turbo versus BASIC. There is very little need for a BASIC when you have Turbo Pascal. It is well written, fun to use at times, and fast enough to make up for its few shortcomings. (See the "At a Glance" page and the text box "A Word About Benchmarks" on page 272 for more information on Turbo Pascal.) It is easily worth its price, even if you use it to develop code that will be compiled on a "professional" compiler. But even by itself it is a bargain that shouldn't be passed up. ■

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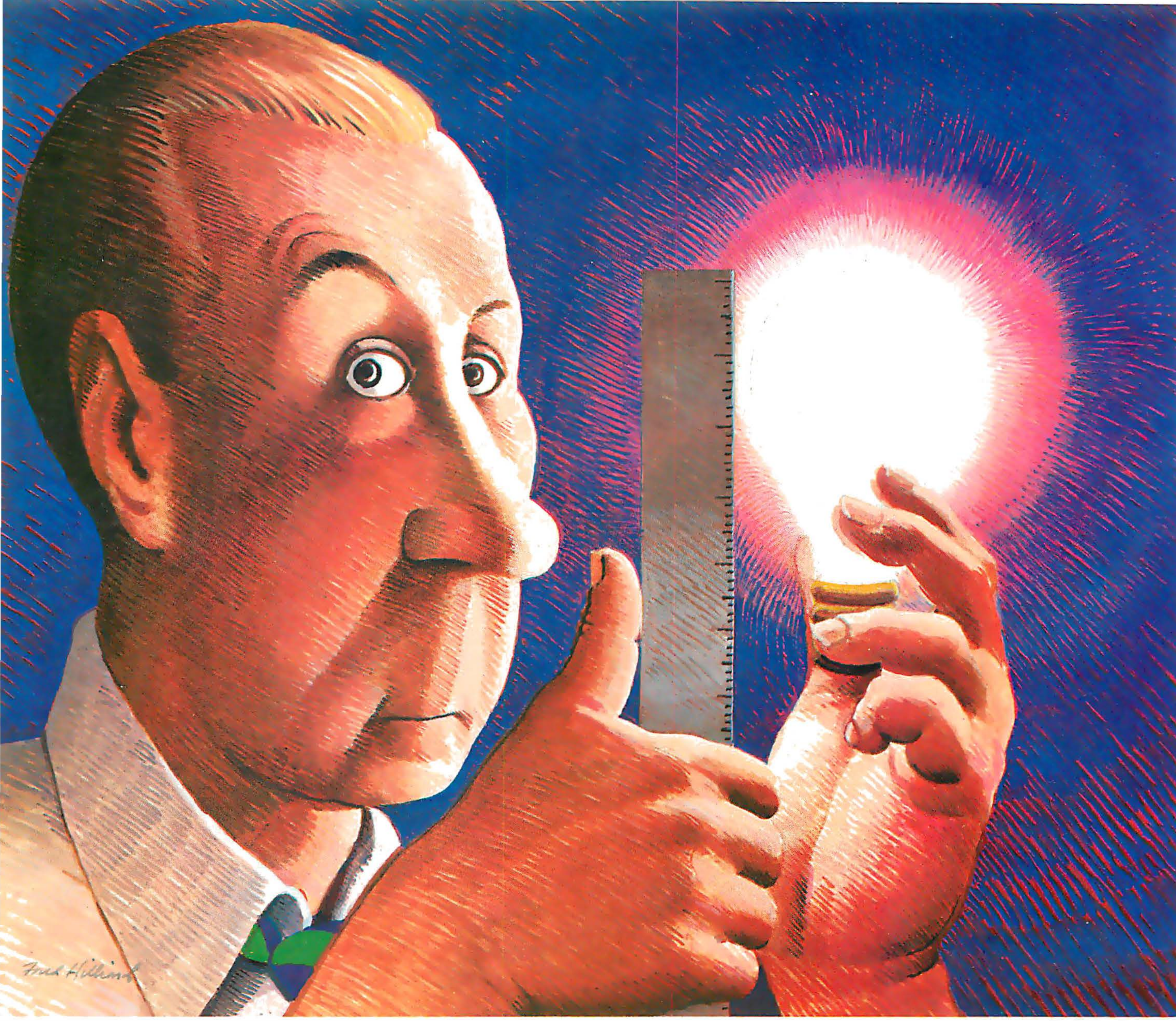
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LISP *for the* IBM *Personal Computer*

IQLISP and muLISP—two versions of a list-based language

BY JORDAN BORTZ AND JOHN DIAMANT

People who own an IBM Personal Computer (PC) are probably glad that many of the greatest programming languages ever written are available for that machine. Now LISP (a list processing language) has joined that group, and LISP is to artificial intelligence as C is to systems programming. Many important applications, including theorem proving, natural language processing, symbolic mathematics, and knowledge-based expert systems, can be done most easily using a list-based language such as LISP.

Some of the better-known LISP programs include MACSYMA, a symbolic calculus program from MIT; Eliza, a simulation of a psychiatrist; and MYCIN, which diagnoses diseases.

LISP has traditionally required large amounts of memory and a fast processor. Most microcomputers are unable to run it. Further, most microcomputer owners are unaware of LISP's power. In this article, we will review two LISP systems for the IBM PC: muLISP from The Soft Warehouse and IQLISP from Integral Quality. To help readers who are unfamiliar with LISP, this article will be divided into two parts: an introduction to LISP and a comparison of these two products.

A BRIEF HISTORY

LISP was developed by John McCarthy from a powerful but hard-to-use language called IPL. McCarthy's LISP language quickly became popular, and people began modifying it for their own purposes. As a result, LISP is anything but a standardized language. At present, three major LISP dialects have emerged as de facto standards: MacLISP, InterLISP, and UCI-LISP. There is now a project at Carnegie-Mellon University to standardize a new version of LISP, known as Common LISP. Common LISP will be discussed more fully in the section on scoping rules.

AN OVERVIEW

As its name implies, LISP is centered around the notion of a *list*. A list is a sequence of *atoms*, other lists, or both. An atom has a single value and can hold a number, character string, or list. Atoms and lists make up symbolic expressions, also known as S-expressions or SEXPRs. As a result, there is no distinction between programs and data as far as LISP is concerned. This means that LISP can write programs for itself to execute. This also means that you will be typing lots of parentheses, since they act as list delimiters. An example can show how all of these elements combine.

First, we assign to the atom 'L' the list (THIS IS A LIST):

```
(SETQ L '(THIS IS A LIST))
```

SETQ binds the list (THIS IS A LIST) to the atom L. The single close quote (alternatively, the word QUOTE) is very important. It tells the LISP expression evaluator not to go to work on anything that follows. This is crucial; without it, LISP would think that THIS is a function and IS A LIST are its arguments. (The double quote is not interchangeable. It is used as a way of enclosing atom names so that they include technically illegal spaces.)

The two biggest list-manipulation commands are CAR and CDR (pronounced could-er). CAR returns the first SEXPR in a list, and CDR returns a list of everything but the first SEXPR. Unfortunately, the names CAR and CDR are horribly non-mnemonic. They originally stood for Contents of Address Register and Contents of Data Register, respectively, on the IBM 7040. The only reason for preserving these names instead of calling them FIRST and BUTFIRST is that you can get a composite called the CADR of X, which is the CAR of the CDR of X. This provides a valuable shorthand; it's easier to say (CADDR X) instead of (CAR(CDR

(continued)

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Listing 1: *An example of some simple* LISP *commands.*

```
-> (SETQ L '(JOHN (AND JORDAN) HACK LISP))
(JOHN (AND JORDAN) HACK LISP)       ;setq returns the list it's
                                    ;assigning
                                    ;to L as its function
                                    ;return value.

-> (CAR L)
JOHN
-> (CDR L)                          ; pronounced halfway
                                    ; between kidder
                                    ; and could-her
((AND JORDAN) HACK LISP)
-> (CAR(CDR L))
(AND JORDAN)
-> (CAADR L)                        ; same as (CAR (CAR (CDR L)))
AND
-> (SETQ L '(A))
(A)
-> L
(A)
-> 'L
L
-> (CDR L)
NIL
```

(CDR X))). Listing 1 contains some more examples. User input is on the lines that begin with the prompt ->. The LISP interpreter's responses are on the line below it. Figure 1 describes listing 1 in graphic form.

Listing 1 also shows an important atom in LISP: NIL. We tried to take the CDR of a list with only one value, so LISP returned NIL, the "empty list." NIL can also be represented as ( ). The other special atom is T. T and NIL are the LISP counterparts of true and false.

LISP assumes (unless told otherwise by the quoting mechanism) that the first atom in a list is a function to be evaluated and the rest of the list contains the arguments to the function. Once again, examples are clearer than rigorous definitions.

```
-> (PLUS 3 5)
8

-> (PLUS 3 (PLUS 4 2))
9
```

A predicate is a function that returns T or NIL depending on whether its argument is true or not. The predicate called ZEROP (pronounced zero-pea) asks if its argument is equal to 0. Another predicate is EQUAL, and it tests equality.

```
-> (ZEROP 0)
T

-> (ZEROP 69)
NIL

-> (EQUAL 5 (PLUS 2 3))
T
```

In addition to providing functions for taking lists apart (CAR and CDR), LISP also contains functions for putting them together, notably CONS (list CONStructor), APPEND, and LIST.

```
-> (CONS 'THIS '(IS A LIST))
(THIS IS A LIST)

-> (CONS '(THIS IS) '(A LIST))
(THIS IS) A LIST)

-> (APPEND '(THIS IS) '(A LIST))
(THIS IS A LIST)

-> (LIST '(THIS IS) '(A LIST))
((THIS IS) (A LIST))
```

Earlier in this article, we mentioned the fact that with LISP there is no distinction between data and programs. The following example demonstrates this and hints at how LISP can be used to simplify algebraic expressions. EVAL is the LISP expression evaluator; it is the opposite of the QUOTE function. EVAL can be called just like any other function. As a matter of fact, the driver loop for LISP (similar to a UNIX shell) in its simplest form is:

```
(PRINT(EVAL(READ)))

-> (SETQ FOO '(1 2))
(1 2)

-> (SETQ BAR (CONS 'PLUS FOO))
(PLUS 1 2)

-> (EVAL BAR)
3
```

LISP and Recursion

Before we discuss defining functions in LISP, let's first delve into recursion. Recursion uses the definition in the definition. For example, we could define a factorial of n as n times the factorial of $n-1$. Of course, since this recursion could go on forever, we have to define a termination condition—something that ends the recursion. For the factorial, we define the factorial of 0 to be 1. Mathematically, we could express this definition as follows:

$$f(x) =: \begin{cases} x = 0 : 1 \\ x > 0 : x \times f(x-1) \end{cases}$$

Let's pictorially trace through this function:

$$\begin{aligned} f(3) &= 3 \times f(2) \\ f(2) &= 2 \times f(1) \\ f(1) &= 1 \times f(0) \\ f(0) &= 1 \\ f(1) &= 1 \times 1 \\ f(2) &= 2 \times 1 \\ f(3) &= 3 \times 2 = 6 \end{aligned}$$

This example may seem artificial. Simplifying algebraic expressions offers a better use. An expression may contain many subexpressions that need to be simplified. To accomplish this, we can write a function called SIMP, which operates on all the subexpressions in the expression it is given and assigns a simpler coded designation to each subexpression. The expressions can be stored as a list of lists, and we can use CAR and CDR to traverse them. This all sounds good, but before we can write something like that, we have to write something easy like the factorial function. Here it is:

```
(DEFUN FACT (X)
  (COND
    ((ZEROP X ) 1)
    (T (TIMES X (FACT (SUB1 X))))))
```

COND is the general-purpose IF... THEN...ELSE statement of LISP. Its general form is:

AT A GLANCE

Name muLISP-83 4.05	**Name** IQLISP
Type Programming language	**Type** Programming language
Manufacturer The Soft Warehouse POB 11174 Honolulu, HI 96828 (808) 734-5801 Microsoft Inc. 10700 Northrup Way Bellevue, WA 98004 (206) 838-8080	**Manufacturer** Integral Quality POB 31970 Seattle, WA 98103 (206) 525-2985
Price $250	**Price** $175
Format 5¼-inch floppy disk, single- or double-sided	**Format** 5¼-inch floppy disk, single- or double-sided
Operating System MS-DOS 1.25 or 2.0 PC-DOS 1.1 or 2.0	**Operating System** PC-DOS 1.1 or 2.0
Computer System Any MS-DOS-based computer with 128K memory	**Computer System** IBM PC or compatible unit with at least 128K bytes of memory (256K for PC-DOS 2.0)
Documentation 150 pages	**Documentation** 300 pages
Audience People interested in artificial intelligence or symbolic mathematics	**Audience** People interested in artificial intelligence or symbolic mathematics

```
(COND
  (< test 1 > ... < result 1 > )
  (< test 2 > ... < result 2 > )
  .
  .
  .
  (< test n > ... < result n > ))
```

If <condition i> is true, COND evaluates <result i> and returns it. Otherwise, it attempts <test i+1>. Since T is always true, the expression following it is evaluated "if all else fails."

A function returns the value of the expression following the parameter list; in this case, the value returned by COND is returned to the function's caller. A simple function that subtracts 1 from any number is provided below:

```
(DEFUN SUB1 (X)
  (DIFFERENCE X 1))
```

Earlier, we said that every atom can have a value, a function, and a property list associated with (bound to) it. The following examples show the use of a property list.

```
--> (GET 'JORDAN 'LAST-NAME)
NIL

--> (PUT 'JORDAN 'LAST-NAME
'BORTZ)
BORTZ

--> (GET 'JORDAN 'LAST-NAME)
BORTZ
```

LISP has several predefined data types: infinite-length integers, floating-point math, character strings, lists, and arrays. As we will discuss later, the two LISPs we are studying do not implement all of the above data types.

IQLISP VERSUS MULISP

The two LISP systems we are comparing are muLISP-83, from The Soft Warehouse, and IQLISP, from Integral Quality. muLISP-83, derived from earlier muLISPs that ran under CP/M-80, runs under any generic MS-DOS computer. It has terminal definition files to select which type of terminal is attached to the computer, enabling running of the muSTAR editor regardless of hardware. If there is no definition for your terminal, you can write your own. IQLISP, on the other hand, runs only on the IBM PC and comparable machines. Unfortunately, there is no clear-cut winner between the two LISPs.

Since LISP is interactive in nature, you spend most of your time under the LISP system. This is unlike a compiler-based environment where you edit the program with your favorite editor and compile it. You can effectively do this with these LISP systems also, but it is more efficient to make changes as you go along, i.e., changing your functions with the built-in LISP editors and testing and debugging them with test data. For that reason, the better the function trace facilities, editor, and debugger, the better for you.

As in any programming language, much of your time is spent editing. In this regard, muLISP wins out. It provides a WordStar-like editor that is screen oriented, and that also helps in matching parentheses by automatically indenting your current line. If the line is indented incorrectly, you know that you have mismatched the parentheses.

IQLISP's editor, on the other hand, is a LISP structure editor; all commands are in relation to an SEXPR's location in the list structure—not its location on the screen. Some people prefer structure editors, but we have found screen-

(continued)

> *LISP is relatively easy to debug because it's interpreted. Both muLISP and IQLISP have good debugging systems.*

oriented editors to be more useful.

ERROR CHECKING

Since programming is very prone to errors, much of the time not spent editing is spent debugging your programs. LISP is relatively easy to debug because of its interpreted nature, but some systems facilitate debugging better than others.

Thanks to a new package for muLISP, both LISPs now have good debugging systems. They both give you roughly the same features, with the exception that IQLISP's debugging system is more oriented toward windows and cursor/control keys. At an error condition, you can ignore the error, escape back to the main read-eval-print loop, or substitute a new value for the expression that LISP was trying to evaluate.

Both LISPs provide good BREAK, TRACE, and BACKTRACE facilities. TRACE enables you to watch the arguments passed to, and the value returned from, whatever function you desire. BREAK causes the system to pause when it invokes the function you have chosen. A BACKTRACE has the system keep track of a TRACE for you and lets you step backward through it.

To facilitate faster execution, muLISP does not do much error checking on its built-in functions. For instance, atoms not bound to anything return themselves—they should cause an error, and they do in IQLISP. This means that if you accidentally misspell a variable in muLISP, you might get strange and undesirable results that are hard to trace. IQLISP, however, complains about the atom being unbound. Similarly, muLISP lets you take the CAR and CDR of atoms, which IQLISP forbids.

IQLISP provides function-key support and windows. Function-key support means you can program the function keys to do whatever you wish. IQLISP's windows are not "true windows": if you put window A over window B and then remove A, B's contents will not reappear.

DATA TYPES

IQLISP also wins out in this category. Integral Quality's system provides all the data types previously mentioned, plus another data type, the short integer. The interpreter automatically stores integers between −32768 and 32767 in short-integer format, thereby saving space. IQLISP also provides floating-point math in two fashions. One is loaded in the software floating-point package and the other is provided through the 8087. Since we don't own an 8087 chip, we could not test this. IQLISP provides a good repertoire of trigonometric functions. muLISP, on the other hand, does not support arrays or floating-point math. Floating-point math will be provided in the next version of muLISP, but that may not be until November.

SPEED AND SPACE

While IQLISP needs at least 256K bytes of memory, muLISP runs comfortably in 128K bytes. The reason is twofold. IQLISP stores its programs in ASCII (American National Standard Code for Information Interchange) code, whereas muLISP stores them in a token-type format known as distilled code (D-Code). Distilled code is three times denser than ASCII code, and program execution is 20 percent faster.

As can be seen from the benchmarks (see the text box on page 288), muLISP is considerably faster than IQLISP. Also, IQLISP ran out of space faster when running the factorial program. This resulted in a garbage collection (GC). LISP produces a GC when it exhausts all of its free memory and attempts to reclaim wasted portions of it. One of the reasons IQLISP requires so much memory is that it uses 4-byte pointers while muLISP uses 3-byte pointers. This enables IQLISP to address more memory; however, unless you have more than 500K bytes, you will have less to work with because of the high 4-byte-pointer overhead. Furthermore, IQLISP pushes more information onto the stack, thereby limiting recursion. If you are going to use LISP for a real-time application, speed can be crucial. For this reason, and because of a greater availability of compatibility packages, we prefer muLISP to IQLISP.

EXTRA FUNCTIONS AND EXAMPLES

With both IQLISP and muLISP, the user is provided with the commented source code to all LISP functions that are non-intrinsically defined. This includes the editor. With muLISP, however, the user is provided with much more. muLISP comes with a tutorial package that leads the user through many of the muLISP functions and demonstrates graphics and methods of implementing features not included with muLISP. In addition, muLISP includes the Doctor program, an implementation of Eliza; Hanoi, a Tower of Hanoi puzzle solver; Animal, in which the computer tries to guess the animal you are thinking of; and Metamind, in which you and the computer play the game of Master Mind. In addition, muLISP provides an InterLISP and a MacLISP compatibility package.

COMPATIBILITY

By virtue of its nature, almost any feature that exists in one kind of LISP can be simulated in another. The price you pay, however, is speed. MacLISP and InterLISP are two of the three major LISPs for mainframe computers. To help convert from mainframe to PC, muLISP provides two compatibility packages that simulate many features of MacLISP and InterLISP.

One of the muLISP compatibility packages attempts to simulate macros. (IQLISP's macros are real.) It is beyond the scope of this article to describe the differences between "real" and "simulated" macros, but the distinction is important for transportability. The fact that the compatibility packages are included with muLISP is a definite plus. Unfortunately, the functions implemented in the two mainframe LISPs are not documented in the muLISP manual, but they are heavily documented in the source code. Although you can print out the source code to make your own

(continued)

Table 1: LISP *load times.*

Version	Time (seconds)
IQLISP	5.0
IQLISP with development system	37.5
muLISP	2.5
muLISP with muStar	9.0



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Both packages let you write your own assembly-language interfaces. IQLISP *has an interface to the* DOS DEBUG *facility.*

manual, the functions are not in alphabetical order and are therefore hard to find. It would be better if The Soft Warehouse added a section to its muLISP manual summarizing function usage. IQLISP provides a function package called HELP.LSP that interactively gives you a synopsis of a function's syntax. This is a nice feature, but it takes a long time to load and consumes valuable memory.

SCOPING

For those of you who will be transporting software from other machines, we will explain binding (or scoping). The two major types of binding are *dynamic* and *lexical*. Lexical binding is the type seen most often in other languages, such as Pascal and C. It binds a variable according to its location in the program (lexical location). Dynamic binding, on the other hand, binds according to when the function is invoked.

```
(DEFUN PLUGH (FROBOZZ)
    (XYZZY FROBOZZ))
(DEFUN XYZZY (KRUFT)
    (PRINT FROBOZZ))
```

If the scoping is lexical, FROBOZZ is undefined in XYZZY because it is local to PLUGH (just as in C). In dynamic scoping, FROBOZZ is still defined because FROBOZZ was bound by the invocation of the function PLUGH, and PLUGH invoked XYZZY. Instead of having just local and global variables, it is possible to have an infinite number of levels of variable declarations depending on what was invoked first.

On the one hand, dynamic scoping is a more powerful facility because some things simply cannot be simulated with lexical scoping. On the other hand, functions that act differently depending on where they are invoked violate the principles of lambda calculus (the theory upon which LISP is based). In fact, under dynamic scoping, if the name of a formal parameter of a function is the same as one already defined by a function invoking it, the result could be wrong. Most of the major LISP interpreters use dynamic scoping (FranzLISP, MacLISP, UCI-LISP, and InterLISP). Be aware, however, that this is not necessarily true of LISP compilers. For instance, Liszt, the FranzLISP compiler, assumes lexical scoping unless told explicitly otherwise. Common LISP attempts to implement both dynamic and lexical scoping. What this boils down to is that programs that run under one scoping will not necessarily run under a LISP with a different type of scoping. Both IQLISP and muLISP are dynamically scoped, but the type of scoping is an important consideration when looking at other LISP systems.

DOCUMENTATION

The documentation that comes with IQLISP is very complete and goes to great lengths to explain the internals of the interpreter. Unfortunately, its indexes are hard to find, which makes it difficult, at best, to use as a reference. The muLISP manual, on the other hand, has a good index and is a handy reference. However, it does not explain the internals of the interpreter as completely as the IQLISP manual. It also neglects to document the compatibility packages.

I/O AND MS-DOS INTERFACES

Both IQLISP and muLISP support cursor positioning and simple graphics, such as plotting points and drawing lines. muLISP supports random-access file I/O (input/output); IQLISP supports only sequential access. Both muLISP and IQLISP support the MKDIR, CHDIR, and RMDIR commands in MS-DOS version 2.0, although they both will run under DOS 1.1.

Only muLISP supports the EXEC call. With EXEC, you can spawn a new shell (command.com), run DOS (disk operating system) as a subprocess of LISP, and then return to LISP with your workspace intact. This lets you go into an editor, modify your code, and then read it back in. It also lets you just go to DOS to print a file. This is a very powerful feature that more applications should take advantage of. Although IQLISP doesn't support the EXEC call, it provides functions to create directories, delete files, and the like.

OTHER FEATURES

Both IQLISP and muLISP let you write your own assembly-language interfaces. IQLISP has an interface to the DOS DEBUG facility, which should aid in debugging assembly-language functions. (We did not test this.) It may be important if you must write many assembly-language functions. However, since IQLISP is so slow, you may have to code in assembly language more often in IQLISP than in muLISP.

Both versions enable you to create SYS files. A SYS file is a snapshot of the computer's LISP workspace. You can stop wherever you are and continue later. More important, a SYS file can be used as a storage area for all of your most commonly used functions. Loading a SYS file is several orders of magnitude faster than reloading the source code

(continued)

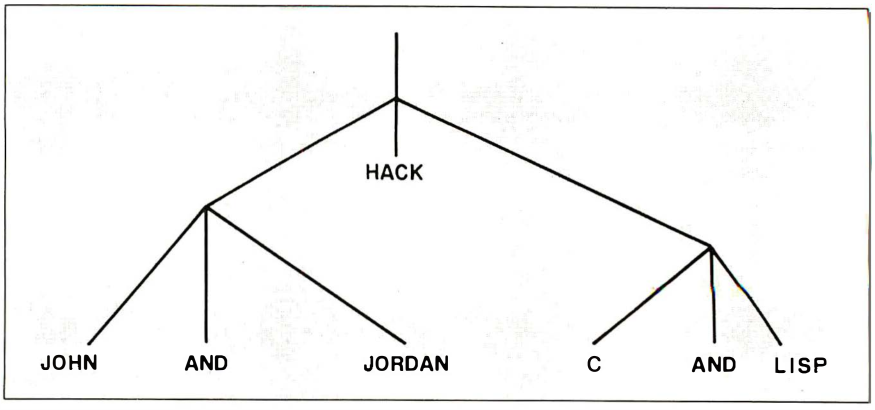


Figure 1: *A list can be visualized as a tree; the terminal nodes are atoms, the nonterminal nodes are lists. The tree shown represents listing 1.*



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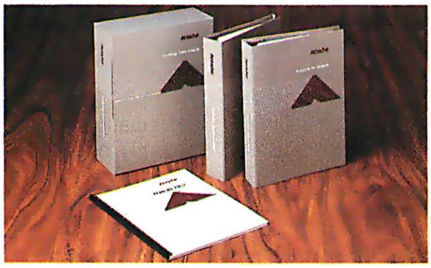
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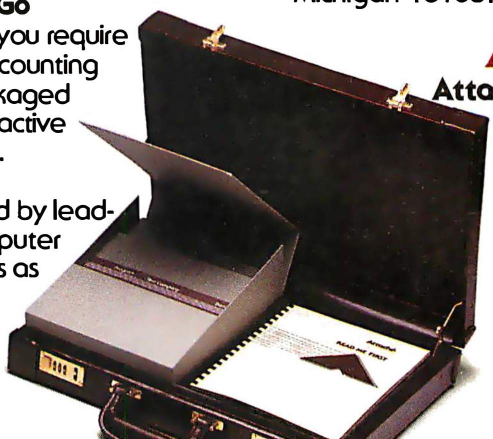
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Benchmarking IQLISP and muLISP

One of our main benchmark procedures is a factorial program, both iterative and recursive (see listings 2 and 3 and tables 2 and 3). The recursive algorithm does about as much calculating as function invoking and is thus a good measure of overall performance. IQLISP was consistently slower by about 40 percent. We tried the iterative solution on IQLISP to see if the function invocation was slowing it down significantly (as the iterative solution avoids the overhead of reinvoking the function). In fact, it turned out that the recursive solution was faster, indicating that either the iterative constructs are inefficient or IQLISP has been optimized for recursion. We also learned that IQLISP has a very slow garbage collector, as was apparent from the wild time fluctuations for different runs of the same tests. When memory runs out (after a couple tests of the functions), the garbage collector is invoked and slows down the function that is running. In addition, we ran up against the limit of IQLISP's stack. IQLISP pushes more information onto the stack with each recursion, which reduces the stack's effective size.

The next test we attempted was a program to compute up to the seventeenth term in the Fibonacci series recursively (see table 5). The series is defined as follows:

$$F(x) = 1 \qquad \text{for } x < 2$$
$$F(x) = F(x-1) + F(x-2) \qquad \text{for } x >= 2$$

This recursive algorithm is highly inefficient and takes considerable time even for low numbers in a series. Nevertheless, it is a good test of how much overhead function calling takes, because the function does very little computing or list manipulating. The time tests indicate that IQLISP again is slower, this time by a whopping 200 percent, leading us to believe that muLISP is much more efficient than IQLISP at function calling.

The third test we performed was based on the Sieve of Eratosthenes (see table 3 and listings 4 through 8). We attempted an iterative and a recursive solution in both LISPs. Since muLISP does not have arrays, they were simulated with lists—i.e., (1 2 3) represents the array having three elements; the first element is 1, and so forth. Due to the extensive amount of list manipulation, the Sieve benchmark shows which LISP handles list processing more efficiently. The tests were performed with an array size of 500, which yielded reasonable times for muLISP (on the order of 1 minute), but wouldn't even execute on IQLISP (memory ran out after about 3 minutes and the command prompt was redisplayed without the function running to completion). Each prime was calculated at about a rate of one every 5 seconds, indicating that if the program would have finished, it would have taken about 5 × 167 seconds, or 835 seconds. Apparently IQLISP is much slower than muLISP (by an order of magnitude) in list processing. However, IQLISP beats muLISP in the iterative Sieve because IQLISP provides arrays.

It is important to realize that even the faster LISP is considerably slower than an efficient compiled language like C, or even a not-so-efficient interpreted language like BASIC. The Sieve benchmark took one-twenty-fifth of the time in C (Computer Innovations' C-86) and one-eighth of the time in BASIC (of course, this was with simulated arrays). Comparable performance was shown when we compared the Fibonacci benchmark in C with the LISP versions. This type of performance is not surprising considering all the overhead necessary to support a LISP environment (garbage collection and pointer manipulation).

Overall, it seems that muLISP is quite a bit faster than IQLISP. However, IQLISP has 8087 support, which helps a great deal. Since we did not have an 8087 available, we could not test its performance; however, for most applications, muLISP would still probably be faster than IQLISP with an 8087.

Listing 2: *A listing of the benchmark in table 2. Note that two slightly different programs had to be used for each* LISP *system.*

For IQLISP:

```
(DEFUN FACT (LAMBDA (X)
   (COND
      ((LT X 2) 1)
      (T (* X (FACT (SUB1 X)))))))
```

For muLISP:

```
(DEFUN FACT(X)
   (COND
      ((LESSP X 2) 1)
      (T (TIMES X (FACT (SUB1 X))))))
```

Listing 3: *The listing for the benchmark summarized in table 3. The program ran on both systems unmodified. Note that* REV *is a slow version of the function called* REVERSE *and that* APP *is a slow version of* APPEND. *They provide a good test of the speed of recursion of the two* LISPs.

```
(DEFUN REV (LAMBDA (X)
   (COND
      ((NULL X) NIL)
      (T (APP (REV (CDR X)) (LIST (CAR X)))) ) ))
(DEFUN APP (LAMBDA (X Y)
   (COND
      ((NULL X) Y)
      (T (APP (REV (CDR (REV X))) (CONS (CAR (REV X)) Y))) )
))
(APP '(A B C D E F G ) '(A B C D E F G))
```

Listing 4: A *recursive version of the Sieve of Eratosthenes written in muLISP.*

```
(PUTD 'DEFUN '(NLAMBDA (NAM$ EXP$) (PUTD NAM$ EXP$) NAM$))

(DEFUN PRIMES (LAMBDA (MAX "%" Local Var: "%" NUMBERS COUNT)
   (SETQ NUMBERS (REVERSE (LISTNUMS MAX)))
   (SETQ COUNT 0)
   (PRIME-AUX NUMBERS)
   COUNT ))
(DEFUN PRIME-AUX (LAMBDA (NUMBERS "%" Local Var: "%" PRIME)
   (COND
   ((NULL NUMBERS) NIL)
   ((NULL (CAR NUMBERS))
     (PRIME-AUX (CDR NUMBERS)) )
   (T (SETQ PRIME (PLUS 3 (CAR NUMBERS) (CAR NUMBERS)))
      (SETQ COUNT (ADD1 COUNT))
      (ELIMINATE PRIME NUMBERS PRIME)
      (PRIME-AUX(CDR NUMBERS))) ) ))
(DEFUN ELIMINATE (LAMBDA (NUM NUMBERS FLAG)
   (COND
    ((NULL NUMBERS) NIL)
    ((ZEROP FLAG)
     (RPLACA NUMBERS NIL)
     (ELIMINATE NUM (CDR NUMBERS) (SUB1 NUM)) )
    (T (ELIMINATE NUM (CDR NUMBERS) (SUB1 FLAG))) ) ))
(DEFUN LISTNUMS (LAMBDA (NUM)
   (COND
    ((NOT (ZEROP NUM))
      (CONS NUM (LISTNUMS (SUB1 NUM))) )
    (T (LIST NUM)) ) ))
```

Listing 5: *An iterative version of the Sieve of Eratosthenes written in muLISP.*

```
(PUTD 'DEFUN '(NLAMBDA (NAM$ EXP$) (PUTD NAM$ EXP$) NAM$))

(DEFUN PRIMES2 (LAMBDA (MAX "%" Local Var: "%" NUMBERS J K
PRIME
COUNT)
   (SETQ J MAX)
   (SETQ NUMBERS NIL)
   (SETQ COUNT 0)
   (LOOP
      ((EQUAL J - 1))
      (SETQ NUMBERS (CONS J NUMBERS))
      (SETQ J (SUB1 J)) )
   (SETQ J NUMBERS)
   (LOOP
      ((NULL J))
      (SETQ K J)
      (SETQ PRIME (PLUS 3 (CAR J) (CAR J)))
      (SETQ COUNT (ADD1 COUNT))
      (LOOP
         ((NULL K))
         (SETQ K (CDR K))
         (SETQ PRIME (SUB1 PRIME))
         (COND
            ((ZEROP PRIME)
               (RPLACA K NIL)
               (SETQ PRIME (PLUS 3 (CAR J) (CAR J)))) ) ) )
      (SETQ J (CDR J))
      (LOOP
         ((OR
            (NULL J)
            (NOT (NULL (CAR J))) ))
         (SETQ J (CDR J)) ) )
   COUNT ))
```

Listing 6: A *recursive version of the Sieve of Eratosthenes written in IQLISP.*

```
(DEFUN PRIMES (LAMBDA (MAX)
   (LET
      (NUMBERS (REVERSE (LISTNUMS MAX))
      COUNT 0)
   (PRIME-AUX NUMBERS)
   COUNT )))
(DEFUN PRIME-AUX (LAMBDA (NUMBERS)
   (LET (PRIME NIL)
   (COND
      ((NULL NUMBERS) NIL)
      ((NULL (CAR NUMBERS))
         (PRIME-AUX (CDR NUMBERS)) )
      (T (SETQ PRIME (+ 3 (+ (CAR NUMBERS) (CAR NUMBERS))))
         (SETQ COUNT (ADD1 COUNT))
         (ELIMINATE PRIME NUMBERS PRIME)
         (PRIME-AUX(CDR NUMBERS))) ) )))
(DEFUN ELIMINATE (LAMBDA (NUN NUMBERS FLAG)
   (COND
      ((NULL NUMBERS) NIL)
      ((ZEROP FLAG)
         (RPLACA NUMBERS NIL)
         (ELIMINATE NUM (CDR NUMBERS) (SUB1 NUM)) )
      (T (ELIMINATE NUM (CDR NUMBERS) (SUB1 FLAG))) ) ))
(DEFUN LISTNUMS (LAMBDA (NUM)
   (COND
      ((NOT (ZEROP NUM))
         (CONS NUM (LISTNUMS (SUB1 NUM))) )
      (T (LIST NUM)) ) ))
```

Listing 7: *An iterative version of the Sieve of Eratosthenes written in IQLISP.*

```
(DEFUN PRIMES2 (LAMBDA (MAX)
 (LET
  (J MAX
   K NIL
   PRIME NIL
   COUNT 0)
   (SETQ NUMBERS (ARRAY 1 (+ 1 MAX)) )
   (FOR J FROM 0 TO MAX
     (STORE (NUMBERS J) 1))
   (FOR J FROM 0 TO MAX
     (COND ((EQUAL (NUMBERS J) 1)
             (SETQ PRIME (+ 3 (+ J J)))
             (SETQ COUNT (ADD1 COUNT))
             (FOR K FROM (+ J PRIME) TO MAX BY PRIME
                 STORE (NUMBERS K) 0)))))
COUNT)))
```

Listing 8: *The iterative Sieve program in* BASIC.

```
10 SIZE = 500
20 DIM FLAG(SIZE + 1)
30 FOR J = 0 TO SIZE
40 FLAG(J)=1
50 NEXT J
60 COUNT = 0
70 FOR J= 0 TO SIZE
80 IF FLAG(J) = 1 THEN PRIME = J + J + 3:COUNT = COUNT +
   1:FOR K = J + PRIME TO SIZE STEP PRIME:FLAG(K) = 0:NEXT K
90 NEXT J
100 PRINT COUNT;" PRIMES"
```

(continued)

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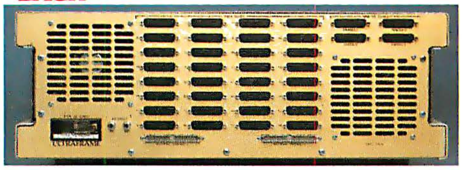
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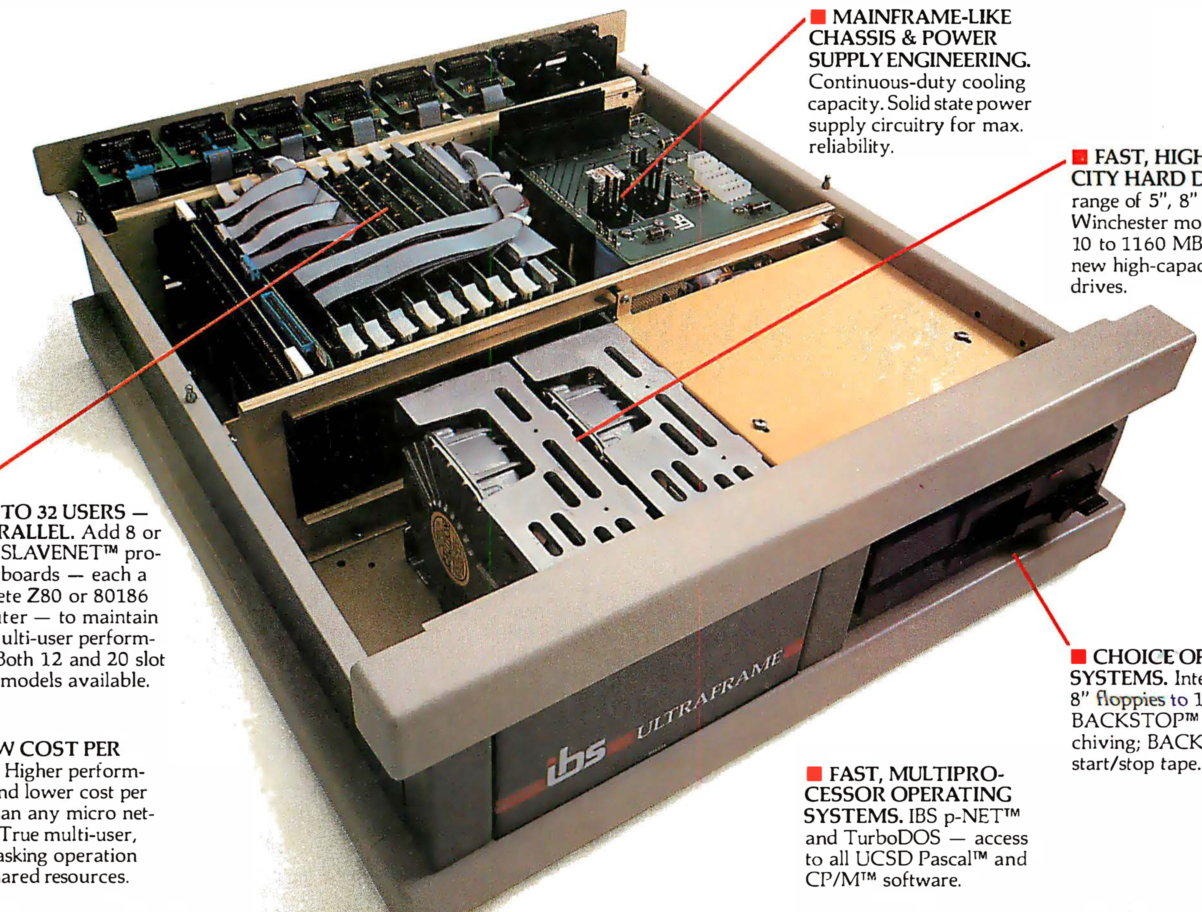
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Listing 9: *The Fibonacci benchmark program written in C.*

```
#include <studio.h>
main(argc, argv            /* calculates fibonacci of parameters */
int argc;
char ** argv;
    {
    printf("%d",fib(atoi(argv[1])));
    }
fib(x)        /* fibonacci */
    {
  if (x < 2)
        return 1;
        else
        return (fib(x - 1) + fib(x - 2));
    }
```

Listing 10: *The Fibonacci program in muLISP.*

```
(DEFUN FIB (X)
   (COND
      ((LESSP X 2) 1)
      (T (PLUS (FIB (SUB1 X)) (FIB (DIFFERENCE X 2)))) ) )
```

Listing 11: *The Fibonacci program in IQLISP.*

```
(DEFUN FIB (X)
   (COND
      ((LT X 2) 1)
      (T (+ (FIB (SUB1 X)) (FIB (- X 2)))) ) )
```

Table 2: *The results of running benchmark 1 as shown in listing 2. The asterisk indicates that the test could not be run because of a lack of floating-point math or because it would take too long to execute.*

Version	Time (seconds) (FACT 30)	(FACT 30.3333)	(FACT 500)
IQLISP	.25	*	19.0
IQLISP with floating-point	1.35	13.0	*
muLISP	.25	*	14.5

Table 3: *The results of running benchmark 2 shown in listing 3.*

Version	Time (seconds)
IQLISP	240.0
muLISP	30.6

Table 4: *The times it took to run the Sieve of Eratosthenes benchmark with an array size of 500.*

Program	Time (seconds) Iterative Algorithm	Recursive Algorithm
CI C-86	4 (more than 2 of which are spent loading the program from disk)	
BASIC	12.0	
muLISP	80.0	95
IQLISP	30.0	would be about 835 seconds if it didn't run out of space

Table 5: *The times it took to run the Fibonacci series up to the seventeenth term recursively.*

Program	Time (seconds)
CI C-86	4.0 (more than 2.0 of which are spent loading the program from disk)
muLISP	8.5
IQLISP	23.0

each time. muLISP goes one step further and lets you create a new LISP .com file instead of just the SYS file.

muLISP has the advantage that the programs you create with it are transportable to 8-bit machines. However, to retain this advantage, your code must not exceed a 64K-byte workspace.

Conclusions

Each of the LISP systems has its own advantages. muLISP is faster, has a better editor, and comes with tutorials and two compatibility packages. IQLISP has better debugging, floating-point math, and more error-checking capabilities. IQLISP also has a friendlier environment and a lower price, but it lacks compatibility packages and is quite a bit slower than muLISP. Overall, we prefer muLISP because of its speed and because of its MacLISP compatibility package.

It may be easier for new LISP users to learn under muLISP because of its tutorial system and the MacLISP compatibility mode. One of the best LISP books on the market, *LISP*, by Patrick H. Winston and Berthold K. Horn (Reading, MA: Addison-Wesley, 1981), assumes a MacLISP environment.

We recommend that you carefully weigh the things you consider most important before choosing a system. Both versions we've discussed are adequate for learning LISP, but muLISP's speed gives it the edge for doing some types of useful work. ■

ACKNOWLEDGMENTS

The authors would like to thank Al Rich from The Soft Warehouse and Robert Rorschach from Integral Quality for providing review copies of their LISP systems. We thank Mr. Rich for adding some more "safety valves" to his LISP system so we couldn't accidentally lose our work. Ralph Hyre and Jon Christenson commented on early versions of the article. We are grateful to Mr. Christenson for the use of his computer when the electricity went out.

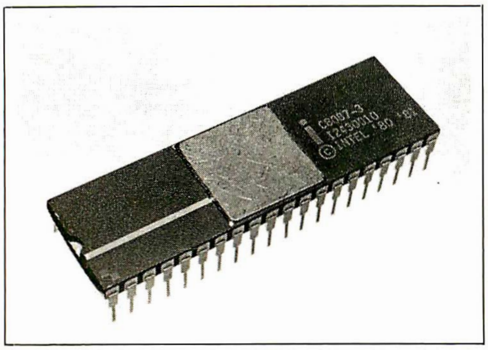
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The Smith-Corona L-1000 Printer

A daisy-wheel unit for light-duty word processing or high-quality program listings

RICHARD S. SHUFORD

The Smith-Corona division of SCM Corporation, long known as a manufacturer of typewriters, created quite a stir when it announced its TP-I daisy-wheel computer printer in early 1982. Previously, no formed-character impact printers had been available at a list price of less than $1500; the TP-I retailed for $895 (see "The Microprocessor's Tenth Birthday" by Chris Morgan, March 1982 BYTE, page 6). Since then, many other manufacturers, most sporting addresses on the western side of the Pacific Ocean, have jumped into the formed-character printer market. The competition inspired product improvements. Smith-Corona first responded with an upgraded machine called the TP-II. A further improvement on the same basic design was marketed for a short time as the TP-II Plus; it featured bidirectional printing and three character pitches. In its latest incarnation, the TP-II Plus has been given a redesigned case and has been renamed the L-1000.

The L-1000 is fairly small as daisy-wheel printers go, taking up less room on a desktop than an average electric typewriter. At 21 pounds (9.4 kg), the L-1000 weighs about half again as much as a typical dot-matrix printer. It does not exactly have a multitude of fancy features: it lacks proportional spacing, single-pass double-striking, and the ability to print super- and subscript characters and graphics. But, in addition to the previously mentioned bidirectional printing and selectable pitch, it does have single-pass underlining and uses a standard print wheel with a character set suitable for computer-program printing as well as word processing.

The L-1000 prints slowly. Smith-Corona rates its speed at 12 cps (characters per second), but the measured speed in a representative Shannon-text benchmark test was slightly less: 11.2 cps. The L-1000 can skip relatively quickly across blank spaces, so sparse documents would show slightly better results.

The L-1000 is also noisy; you wouldn't want to hold a telephone conversation nearby during printing. But most other daisy-wheel printers are also loud enough to be an annoyance.

EXTERNAL CONTROLS

The front panel of the printer contains a power-on light and three rocker switches. One switch selects the printing pitch of 10, 12, or 15 characters per inch (cpi); the second selects the paper-handling mode (top-of-form or "normal"); and the third actuates formfeeds (or linefeeds) or selects the self-test mode. On the back of the case are the rocker power switch, the power connection, a 36-pin female Centronics-type parallel input/output (I/O) connector, and a female DB-25S serial RS-232C I/O connector. Behind a removable louver in the back are two sets of DIP (dual-inline pin) switches for selecting some printer control parameters that are infrequently changed; these parameters include the serial data rate, polarity of the serial handshaking signal, the response to carriage-return and linefeed characters, the use of different print-wheel character sets, and the length of the paper (either the North American 11 inches or the Deutsche Industrie Norm 29.7 centimeters).

Using the printing-pitch switch is simple enough—just set it to match the currently installed print wheel. The switch controlling the paper-handling mode requires explanation. The top-of-form mode is of use chiefly with continuous fanfolded paper, enabling the printer to automatically provide four-line top and bottom margins on 11-inch sheets (or five-line on 29.7-centimeter sheets). The other choice is called "normal" mode, in which vertical movement of the paper occurs only in increments of one line; a formfeed character causes the same behavior you'd expect from a linefeed character.

The normal mode is intended for use when you are feeding single sheets by hand. But even with continuous-form paper I had to use normal mode most of the time because the word-processing programs I use (The Final-Word and SuperWriter) keep track of the print position and do not expect the printer to skip lines by itself. (Few word-processing programs

(continued)

Richard S. Shuford is BYTE's special projects editor. He can be contacted at POB 372, Hancock, NH 03449 *or through Source account* TCG847.

expect to receive much help from the printer in page formatting. You must be able to turn off the printer's formatting features to prevent strange results from two kinds of formatting being applied at once.)

The labeling on the mode switch is confusing. To get the normal mode you flip the switch to the position marked "CLEAR" and "−" (minus sign). The switch position for top-of-form mode is marked "SET" and "+" (plus sign). Neither label is self-explanatory.
sign). Neither label is self-explanatory.

The third front-panel switch, marked "Form Feed/Self Test," is a momentary-contact type. Its function is changed by the paper-handling mode. In top-of-form mode, pressing the switch causes the paper to advance to the top of the next form; in normal mode, the paper is fed by only one line. This function does not automatically repeat; when using the normal mode with continuous paper, I sometimes had to press the third rocker switch 50 times or so to get the page out.

Table 1: *Command codes used to invoke functions of the L-1000.*

Command Code	Function
ESC US FF	set printing pitch at 10 cpi
ESC US LF	set pitch at 12 cpi
ESC US BS	set pitch at 15 cpi
ESC C	set top and bottom margins to edges of sheet
ESC E	begin underscoring all characters
ESC FF n	set page length at *n* lines
ESC L	set bottom margin
ESC R	stop underscoring
ESC S	set page length and margins at DIP-switch default
ESC T	set top margin
ESC Z	begin underscoring alphabetic characters
ESC 9	set left margin
ESC 1	set tab stop at current location
ESC 8	clear tab stop at current location
ESC 2	clear all tab stops
ESC /	begin bidirectional printing (default)
ESC \	stop bidirectional printing
HT	move right to next tab stop
CAN	margin release for printing current line

Abbreviations

ESC—Escape character
US—unit-separator character
FF—formfeed character
LF—linefeed character
BS—backspace character
HT—horizontal tab character
CAN—cancel character

Programmable Controls

The L-1000's special print functions, as with most computer printers, are invoked mostly by means of programmed control sequences it receives along with the printable characters. The functions include changing pitch, setting the left, top, and bottom margins, setting up to 16 tab stops, and underscoring. All the special commands except one begin with the ASCII (American National Standard Code for Information Interchange) Escape character; the functions and their control sequences are shown in table 1. The exception to using the Escape character is the margin-release function, which disables for just one line the left margin set on the printer. A bare CAN (cancel) control character invokes the margin release.

The printer responds to a few other nonprinting ASCII control characters: the backspace (BS) character causes the print mechanism to back up, the horizontal-tab (HT) character causes the printer to quickly skip to the next tab stop, and the formfeed (FF) character causes a formfeed (but not in normal mode). The L-1000 contains no bell or buzzer, so BEL does nothing. When the printer is controlling receipt of characters from the computer via software handshaking, it sends the DC1 (X/ON) and DC3 (X/OFF) control characters to start and stop the flow of data.

Table 2: A *comparison of printing speeds of three daisy-wheel printers. Printing was done bidirectionally; all times are in seconds.*

Test	Smith-Corona L-1000	Diablo 630	Juki 6100
80-column Shannon text	51.0	15.2	33.9
60-column Shannon text	51.4	15.3	33.7
First-order English	87.3	27.8	58.8
Fourth-order Shakespeare	71.7	22.4	48.8
First-order UNIX manual	84.0	22.3	58.1
Spreadsheet simulation	95.8	28.6	68.6

The printer can be instructed via DIP-switch settings to recognize the linefeed character as a "newline" character and perform both a carriage return and a linefeed operation upon its receipt. Or the DIP switches can tell the printer to perform a linefeed automatically after every carriage return. The L-1000 comes from the factory set up to require explicit return and linefeed characters.

The L-1000's relative lack of special features can be considered an advantage in one way. Users of some printers capable of many functions commonly become frustrated trying to find commercially available software that can use all the cute tricks. For example, an owner of a Diablo 630 discovers that WordStar cannot issue commands for true proportional spacing, which the

(continued)

AT A GLANCE

Name
Smith-Corona L-1000

Type
Daisy-wheel printer

Manufacturer
Smith-Corona
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New Canaan, CT 06840
(203) 972-1471

Price
$545

Optional Equipment
Tractor feed, $149
Extra print wheels

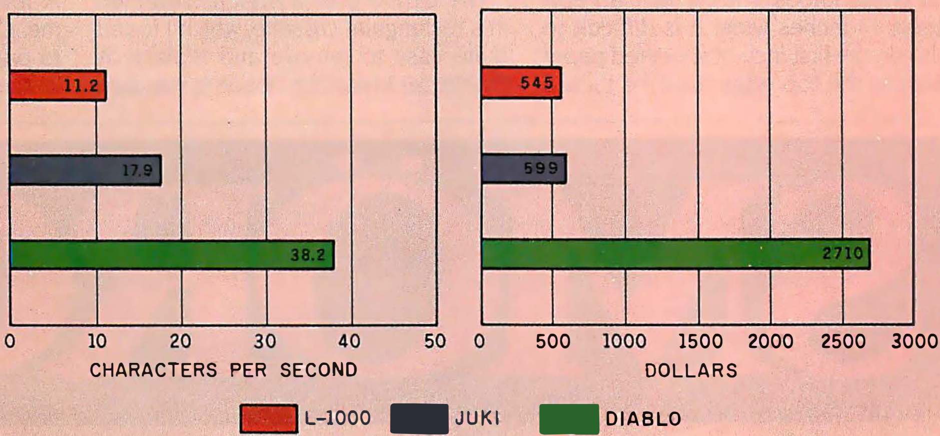
Documentation
28-page booklet

Advertised Print Speed
12 cps

Warranty
90 days

Audience
People who want a low-cost formed-character printer for light-duty work





This is the L-1ØØØ (Tempo 1Ø). This is the L-

This is the L-1000 (Pica 10). This is the L-

This is the Juki 6100. This is the Juki 6100

This is the Diablo 630. This is the Diablo 6

The Smith-Corona L-1000 printer is compared with the Juki 6100 printer (using a Courier 10 daisy wheel) and the Diablo 630 (using a Courier Legal 10 daisy wheel). The L-1000 is using the ASCII Tempo 10/12 and the Pica 10 print wheels. The pitch for all printers is 10 characters per inch. The prices shown do not include tractor-feed mechanisms. The print speeds were determined by timing how long it took the printers to run the 60-column Shannon test (573 characters; see "The Art of Benchmarking Printers" by Sergio Mello-Grand, page 193 in the February BYTE).

630 is certainly capable of. People who buy the L-1000 will at least not have that particular difficulty.

The L-1000 is new enough that few prewritten programs explicitly support it. Software written to use the Smith-Corona TP-I will probably work with the new model if the L-1000's default mode of bidirectional printing does not get in the way. The only means of turning this feature off is by sending the ESC\ (Escape-backslash) command, the ease of which depends on the application.

ROUTINE USE

The printing and paper-handling mechanisms reflect their typewriter heritage. If you've used a typewriter, you should have no trouble loading single sheets of paper into this printer. It has the familiar paper bail, guide, release, and platen knobs. The carriage accepts sheets 13 inches wide. It is difficult to print on the first inch of sheet-fed paper because the top edge must be tucked under the paper bail for proper feeding. (This limitation is shared by many other printers and typewriters.) But small Rolodex cards can be inserted and printed on with little trouble.

The line-space selector can set the paper-feed linkage to print 6 lines per inch (lpi), 4½ lpi, or 3 lpi. This seems to be an heirloom from typewriter technology; I suspect that the 6-lpi setting will be appropriate in nearly all computer applications.

The optional tractor-feed attachment was not available for this review, but I tried printing on continuous fanfolded paper loaded into the unassisted friction-feed platen. It worked surprisingly well as long as I straightened the paper every 20 pages or so. However, Smith-Corona does not recommend operating the printer in this manner.

The L-1000 uses a ribbon contained in a rectangular cassette, which I found quite easy to remove and replace. A multistrike Mylar-film ribbon is standard equipment, but fabric and single-strike film ribbons are available. An impression control can vary the force with which the print hammer strikes the print wheel.

Smith-Corona provides an adequate selection of optional print wheels for printing text in English and several other European languages; the L-1000's wheels have 93 character positions and are identified by a red ring. Because the handling knobs on the print wheels have sharp edges and removing the print wheel requires a fair amount of force, the process is slightly painful. The ribbon must be removed to change the print wheel. The front of the printer's case flips up on a hinge for access to the ribbon and print mechanism.

ANNOYANCES

A few things about the L-1000 annoy me. Often when first turned on, it fails to print the very first character sent to it. And the initialization routine it goes

through at power-up always performs a linefeed, throwing the paper registration off by one line. I observed some strange behavior in the bidirectional-printing logic, which sometimes brought the print mechanism back to the left margin only to tab it back to where it just came from.

I don't care for the type font of the standard print wheel, ASCII Tempo 10/12, although it certainly does contain almost all the special characters you need for printing computer programs. (Oddly, it lacks the accent grave.) The ASCII Tempo characters are rather square, as though they are meant to imitate the output of a dot-matrix printer, and the slashed zero seems out of place in formal correspondence. Smith-Corona suggests that the print wheel can be used at either 10 or 12 cpi (thus the "10/12"), but I think ASCII Tempo text looks sparse at 10 cpi.

Like many printers, the L-1000's RS-232C serial interface is set up in the DTE (data-terminal equipment) configuration, receiving data on pin 3 and transmitting on pin 2. This is fine if you want to connect the printer to a modem, but it's not so fine if you want to connect it directly to a computer: most computers also receive on pin 3 and transmit on pin 2. You have to make or buy a special cable that crosses the connections between pins 2 and 3. The L-1000 uses both pin 4 (ready to send) and pin 20 (data terminal ready) of the RS-232C line to transmit its printer-busy status to the host computer. The printer comes from the factory set at 1200 bps (bits per second), with 8-bit data characters, even parity, and 1 stop bit; 7-bit data characters are more common.

Conclusions

The current list price of the L-1000 is $545, with the tractor-feed option an extra $149, but considerable discounts are available. (Some dealers would rather include the discount as part of a complete system deal.)

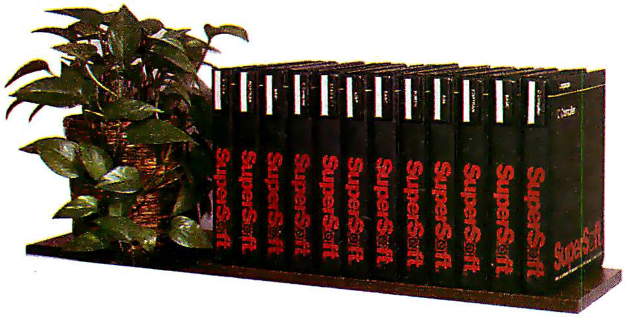
Should you buy the L-1000? Maybe, if its limitations don't bother you, and if you can buy it at a good discount. But at $545 its price/performance ratio is somewhat below that of other printers now on the market.

If you decide to buy the L-1000, make sure that you can obtain a properly wired serial cable. And check the dealer's supply of print wheels for fonts other than ASCII Tempo 10/12, unless you like square characters.

The Smith-Corona L-1000 is not packed with fancy features, but it performs the basic printing functions most people require. The tractor-feed option and the computer-type standard character set is satisfactory for printing program listings and for other technical uses. The L-1000 is most at home in light-duty applications, printing individually prepared letters and other short documents on single sheets of paper fed by hand. ■

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If you have used other languages without BCD math, you know how disconcerting decimal round off errors can be. For example:

With IBM PC* BASIC	With SuperSoft BASIC with BCD math
10 A=.99 20 PRINT A 30 END	10 A=.99 20 PRINT A 30 END
Output: .9899999	Output: .99

As you can see, SuperSoft BASIC with BCD provides greater assurance in applications where accuracy is critical.

SuperSoft's BASIC is a true native code compiler, not an intermediate code interpreter. It is a superset of standard BASIC, supporting numerous extensions to the language. Important features include:

- Four variable types: Integer, String, and Single and Double Precision Floating Point (13 digit)
- Full PRINT USING for formatted output
- Long variable names
- Error trapping
- Matrices with up to 32 dimensions
- Boolean operators OR, AND, NOT, XOR, EQV, IMP
- Supports random and sequential disk files with a complete set of file manipulation statements
- IEEE floating point available soon as an option
- No run time license fee

Requires:	128K memory
BASIC compiler:	$300.00

For CP/M-86,® MS DOS, and PC DOS

*SuperSoft BASIC is compatible with Microsoft BASIC interpreter and IBM PC BASIC. Due to version differences and inherent differences in compilers and interpreters some minor variations may be found. Machine dependent commands may not be supported. The vast majority of programs will run with no changes.



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STATISTICS REFIGURED

"Statistical Software for Microcomputers" by James Carpenter, Dennis Deloria, and David Morganstein (April, page 234) was excellent. Thoughtful, competitive reviews like this are one of the main reasons I subscribe to BYTE. The authors should be commended.

BARRY GORDON, M.D., PH.D.
4340 Roland Springs Dr.
Baltimore, MD 21210

Thank you for including three of Dynacomp's packages in your recent survey, "Statistical Software for Microcomputers." We congratulate the authors on their time-consuming analysis.

On the whole we found what was said about Dynacomp's products to be fair and technically objective. However, Dynacomp has received several calls from owners of these and other products who think that the review was unfair. In each case their objections related to what was *not* said in the review. I will briefly relay the comments we have heard.

1. The review states that the Dynacomp documentation is brief (only about 14 pages), whereas the competitive products have manuals of 100 pages or more. Out of context this apparently reads (it didn't to us) as a negative comment. However, the authors stated that they had no problems at all running the Dynacomp programs, whereas they did with some of the other products tested. The connection perhaps should have been made that the Dynacomp manuals served their purpose well and led to flawless program performance.

2. The review accurately states that the three Dynacomp products examined are limited in capability. There is absolutely no error here. Dynacomp feels that if you want to do nonlinear regression you should not be forced into buying a more comprehensive package costing ten times as much in order to use the one feature you want. The customers who called us pointed out that this was one of the strong features of the Dynacomp product selection.

3. Another complaint we heard was that none of the other 13 packages carried by Dynacomp were mentioned. Collectively, these cover almost all the features of the competitive products mentioned in the review and offer additional capabilities (e.g., sample planning, principal components, and others). They range in price from $19.95 to $249.95. The three Dynacomp packages reviewed were in the $20 to $30 range.

I realize it would be unfair to include all of Dynacomp's statistics packages in a comparative review because Dynacomp would then dominate the list.

Having been in the position of a reviewer in the past, I appreciate the difficulty (sometimes impossibility) in presenting a balanced evaluation given the limitations of available magazine space. BYTE has high standards in this respect, and its reviews are generally very professionally done. All I offer in this note is a condensation of some customer responses.

DR. F. R. RUCKDESCHEL
Dynacomp Inc.
1427 Monroe Ave.
Rochester, NY 14618

The article "Statistical Software for Microcomputers" in your April issue provides a much needed service to the large community of professional data analysts.

Although we appreciate the reviewers' determination that our product, Statpro, is "far and away the most comprehensive package," we would like to respond to several inaccuracies concerning both Statpro and our company.

The Statpro IBM-PC version *is* available for sale at this time while our PC XT version will be released in August 1984. We also have both an Apple II and Apple III version of Statpro available, the latter of which operates in either a floppy- or hard-disk environment.

Lastly, our correct company name is Wadsworth Professional Software Inc. Interested readers can contact us at (800) 322-2208 for further product information including a Statpro demonstration package.

RICHARD J. DUNFEY
Wadsworth Professional Software Inc.
20 Park Plaza
Boston, MA 02116

MORE THAN MICRO-LOGIC

We were interested by Rich Krajewski's objective review of Micro-Logic in April. It especially interested us because we sent a similar product to BYTE approximately two and a half years ago, and it only received coverage on page 441 in the Software Received section of the March 1982 issue.

Speaking from a biased point of view, we feel that we have a better product at a better price, the CDS Circuit Design System. Here is a partial list of the convenient features of CDS:

- Boolean minimization of up to seven variables
- User-oriented documentation with index, bibliography, and transparent overlays
- User-defined devices and graphics
- Complete on-screen circuit documentation
- On-screen circuit simulation
- Fast and easy interdevice connections
- Circuit cascading with virtual (disk drive) memory
- A price of only $149

We feel that in order to do justice to your readers you should review other similar simulation/design packages.

TODD K. MOON
Smart Software
POB 1292
Orem, UT 84057

I read with great interest Rich Krajewski's software review, "Micro-Logic," in the April issue of BYTE (page 224). We have a somewhat similar product called Hard that differs from Micro-Logic mainly in the following aspects.

Hard costs $45 rather than $475. It is extremely easy to learn and use; in fact, it has been designed for education. It runs on any CP/M-based system and does not require graphics since its input is via a simple hardware description language. This does not preclude output comparable to that of Micro-Logic. And though it is, overall, slightly less sophisticated than Micro-Logic, it has a few extra features, such as simulation of random noise.

DR. IVAN TOMEK
Modular Systems
POB 1456
Wolfville, Nova Scotia
B0P 1X0, Canada

OVER THE RAINBOW—AGAIN

David Suits's review of the Rainbow 100 is probably the most comprehensive description of this machine that I have read to date.

I can only reinforce his comments concerning the difficulty and expense of obtaining technical documentation, such as the BIOS listings, from DEC. However, a number of users groups are now springing up, and many provide basic technical libraries to their members.

Contrary to what is suggested in the review, the 96-track-per-inch format of the Rainbow disk drives gives the Rainbow hardware the ability to read virtually any single-sided, soft-sectored format. In fact, an inexpensive program called Media Master from MDG & Associates of Moorpark, California, allows the Rainbow to both read and write in over twenty different formats in both CP/M and MS-DOS.

More problematic is the VT-100/VT-102 screen

(continued)

handling. While Mark Siegel's article, "Toward Standard Video Terminals: ANSI X3.64 Device Control" (April, page 365), praises the ANSI standard, much CP/M software continues to be written for the Lear Siegler ADM-3 (or other proprietary screen formats) and hence is not easily transportable. As ANSI X3.64 gains its rightful acceptance, the virtue of the DEC Rainbow's VT-100 implementation will be truly appreciated.

For more of a flavor of the level of technical involvement of many Rainbow users, BYTE readers are encouraged to drop in on the Rainbow subarea of the VAXsig (special interest group) on CompuServe.

William Lee Roberts
Fort Street Investment Corp.
Suite 2000
425 California St.
San Francisco, CA 94104

I am surprised. In spite of recent controversies over reviews versus previews, BYTE has always maintained a reputation of technical accuracy and objectivity. The benchmark report in "The Rainbow 100" (April, page 170) contains several errors and at least one missing piece of information.

The major error is one that I am sure many others caught—the comparison of execution time for the prime-number program using integer variables on the Rainbow versus use of floating-point (real) variables on the Victor 9000 and IBM PC. David Suits reports that he changed to use of integer variables because "using real variables, MBASIC-86 gave . . . an OUT OF MEMORY error when [he] tried to dimension the 7001 element array" in the program. How much memory was in his test system? Was it the same as in the Victor and IBM systems previously tested? Though Professor Suits notes that he "use[d] integer variables to conserve memory," why even proceed in this direction? Without considering the differential overhead in arithmetic operations for integer and real numbers, the fact that integers take up less memory indicates that a system has to do less work when dealing with them.

Professor Suits does not profess to be a computer professional. To the contrary, his review is from the point of view of the average intelligent user of the system. But where was the review editor? I support the idea of using external reviewers, especially those who can contribute reactions from the user viewpoint. However, if this tact is taken, your editorial staff should take extra care in checking the information provided and the results of comparative tests. Here is a case of not only comparing performance using two different data types, but also comparing across operating systems (CP/M-80/86 versus MS-DOS) and versions of BASIC (MBASIC versus IBM-BASIC). I am glad that Professor Suits sensibly made only the general conclusion that the systems "seem fairly evenly matched."

By the way, the time for the prime-number program on a Rainbow 100 using floating-point variables is about 205 seconds, about 10 percent higher than the 183.5 seconds recorded when using integers.

One further point: it is the Delete key that acts like an old-style rub-out key in BASIC: the Backspace key performs as might be expected from other microcomputers. The catch is that, keeping with DEC standards, the Delete key is the normal correction key at the operating system level and in many other applications. It is easy to agree with David Suits that this is disappointing and confusing.

In closing, I simply request that the usual high standards observed in articles by your technical staff also be enforced for contributed reviews. If comparisons are going to be made between systems, make sure that the tests are equivalent and that any other information important to interpretation is provided.

Lawrence Jones
211 Northview Road
Ithaca, NY 14850

The purpose of our system review benchmark tests is not to compare operating systems or microprocessors, but to compare complete systems. We wanted to compare the DEC Rainbow as we received it (that is, with 64K bytes of RAM, its standard operating system [CP/M-86], and its BASIC interpreter) with the IBM PC and Victor 9000 as we received them (that is, with 64K and 128K bytes of RAM, respectively, and their standard operating systems [MS-DOS] and BASIC interpreters). We used a group of simple tests. Our reviewer found that one, the Sieve of Eratosthenes prime-number program, would not run on the Rainbow. The reviewer modified the program to allow it to run on the Rainbow. He accurately reported his procedure and his results.—Rich Malloy

Finally, I've found a review of the DEC Rainbow. My father bought one of these machines several months ago, and ever since, I have been trying to do some serious programming with it. Since the documentation that came with the machine lacked any information concerning the BIOS or any aspects of architecture, the possibility of my doing any sort of "fancy" programming was limited.

After finding out that the DEC technical package had a price of $275 on it, I decided to wait for the BYTE review hoping that some useful information might appear in that. As it turns out, Dr. Suits ran into the same problem I did. Refusing to believe that DEC would try to prevent programmers from obtaining information by pricing it out of the market, I decided to make a few phone calls.

The magic number turned out to be the DEC Part Number Information Line. They were able to give me the following part numbers: AA-X355A-TV, *The MS-DOS Programmer's Reference Guide*, and AA-X432A-TV, *The Rainbow BIOS Listing*. A quick call directly to DEC and I found out the prices: $21.00 for the reference manual and $14.00 for the BIOS listing.

I just ordered them today, so I don't know what exactly is in the reference guide, but according to the description in the MS-DOS *Advanced Users Guide*, the programmer's guide has information on architecture, device drivers, system calls, and interrupts. So the information crisis is apparently not as bad as it seems, and once again I am the proud user of a DEC Rainbow.

Mark D. Esswein
1730 Court Petit
McLean, VA 22101 ■

Kernel



THIS MONTH the Kernel welcomes the first installments of BYTE Japan, written in Tokyo by Contributing Editor William Raike, and Mathematical Recreations, by Contributing Editor Michael W. Ecker. William Raike reports on his experiences with the Seiko wrist computer and tells us that 256K-bit RAM chips are now available in single-unit quantities in Akihabara. Michael W. Ecker closes the section with some insights into the phenomenon of invariance.

Jerry Pournelle opens the July Kernel with a far-ranging discussion that dwells on AT&T's 3B2 and Apple's Macintosh. In BYTE West Coast, John Markoff describes some recent trends in telecommunications.

The August issue will introduce a new column, BYTE U.K., by Contributing Editor Dick Pountain. He is the former managing editor of *Personal Computer World* and editor in chief of *Soft*, two of England's top personal computer magazines. Dick will write for us regularly from London.

C·O·M·P·U·T·I·N·G
A·T C·H·A·O·S M·A·N·O·R

The AT&T Computers

3B2/300 Computer
AT&T/IBM PC Link
Sage Computers
Macintosh
The Creator
PBASIC
Eureka!
Z-100 RAM Disk
Z80/iAPX286 Board
CompuPro 8/16
Printer Optimizer
Quickon
Disk Maker I
Calendar/I
Infocom Games

BY JERRY POURNELLE

I've just come back from COMDEX Winter in the Los Angeles Exposition Center, where I got to play with the new AT&T computers.

Like, Wow!

When AT&T announced a computer line, there was a bit of panic on Wall Street; after the prices were announced, the excitement died away. Too expensive. Who's worried about a computer line whose lowest-cost item is a $9950 desktop? How can that affect the micro world? That's what many Wall Street analysts said, anyway.

Dream on.

I don't own any computer stock—the conflict of interest is obvious—but if I did, I'd give that analysis a lot of thought. People, that AT&T desktop computer is one hell of a machine.

True: just now, as I saw it, with little application software, it's not much of a threat to anyone; but give it time, and there'll be a different story. The AT&T 3B2/300 desktop provides an awful lot of bang for the buck. If I seriously wanted into the software business, I'd buy a 3B2 development system and get to work polishing up my skills in the C programming language; and I'd expect to get rich from it.

AT&T quotes a four-week delivery time on the 3B2/300. With half a megabyte of memory (plus 32K bytes of ROM [read-only memory] for bootstrapping and housekeeping), it costs $9950 "with standard industry discounts available." What you get is the basic machine built around the WE 32000 microprocessor chip, one 5¼-inch floppy disk, a Quantum 10-megabyte hard disk, two RS-232C ports, the UNIX System V operating system extended with a number of popular UNIX utilities such as YALOE and YACC (Yet Another Line-Oriented Editor and Yet Another Compiler-Compiler), and the Vi editor from Berkeley UNIX.

The WE 32000 chip is a true 32-bit microprocessor; it corresponds somewhat to the National Semiconductor 32032 or the Motorola 68020. It's also capable of 8- and 16-bit operations. Moreover, AT&T is committed to heavy-duty silicon support of the system: at the moment, the WE 32000 system has an external memory-management unit (MMU) and other external support chips. The whole system is designed to interface with UNIX. AT&T plans in the future to combine the microprocessor, MMU, and other support into a single chip, thus increasing both speed and reliability; AT&T's people say the new chips will be upward compatible with the present 32000 systems.

As I write this, memory for the 3B2 is $2400 per megabyte. AT&T makes 256K-bit memory chips and bundles them in clusters to make 1-megabyte boards no larger than a paperback book. Alas, I didn't think to photograph one of the boards next to one of my paperbacks to illustrate the point, but a megabyte contains about 166,000 English words: the AT&T memory board could hold all the words in one of my novels and have room to spare.

You'd undoubtedly want a full megabyte of memory for a development system, and indeed, to handle full UNIX you'll probably need two; so the base price for a real-world development system is more like $14,500. We'd also want to upgrade the disk to at least 40 megabytes: that's $2000 more. Finally, AT&T will sell you a wonderful terminal with a bit-mapped screen and its own WE 32000 processor to run it; that's an additional $5000, so our development system costs $22,000; hardly cheap.

However: we now have all we need. For an additional $500 per user (less if we want to use less expensive terminals), we can add up to 15 more users. The system is full multitasking, multiuser UNIX: we can let each of our terminals run more than one job. I saw 20 simultaneous jobs running on the 3B2/300, and that didn't seem to slow it down much.

THE DEATH STAR CONNECTION

One of the strangest sights I ever saw was the AT&T "Death Star" logo on an IBM PC; but there it was. You can use the PC as a terminal for the 3B2/300. AT&T, in conjunction with

(continued)

Jerry Pournelle holds a doctorate in psychology and is a science-fiction writer who also earns a comfortable living writing about computers present and future.

Locus, a small but highly competent Santa Monica software house, has worked out the hardware and software to network the 3B2 with the PC. What we saw running at COMDEX used a 3-Com Ethernet board in the PC and the regular 3B2 Ethernet board; but the software will work just as well with Omninet or (at lower speed, of course) with a straight RS-232C connection. That means we could connect up a Corvus Concept or any other machine that supports Omninet; or, if we want to write the interface driver, any machine with an RS-232C interface.

This gives the 3B2 a lot of flexibility. Even with all terminals and the networking and throwing in a good printer, we're under $30,000 for a 10-user system with full UNIX.

There's more, though.

Opening Windows

What I saw running on that 3B2 wasn't any ordinary UNIX: this UNIX had windows and a mouse, and while it didn't yet have icons, it had nearly all the capabilities you expect from Apple's Lisa, only this was loaded down with multiple users and was still *fast*. Yet more: using that marvelous bit-mapped screen you can run programs under the debugger and see the program output in one window, the debugger in another, and the source code in a third—while having one or two other application programs running along in still more windows. The debugger lets you insert breakpoints, step the program along line by line through the source code, and get the contents of the registers; i.e., it offers all the features you'd expect from a good debugging utility. I'm told it's an outgrowth of the BLIT windowing UNIX prototype, but it has a lot more capability.

The debugging system takes advantage of the speed and power of the WE 32000 in the terminal. Windowing is managed about the way you'd expect, with pull-down menus and the ability to change window size and shape and shuffle the windows to put the one you like on top; all this is done with the mouse in much the same way that Wirth's Modula-2 operating system works. I suppose I shouldn't be surprised, since most of these concepts have previously appeared at the Xerox Palo Alto Research Center (PARC); the whole micro community owes Xerox a vote of thanks for acting as the software R&D center for the industry. I can't imagine why Xerox doesn't market some of the goodies that have been developed, instead of exporting them to competitors, but these discoveries sure helped us all.

In any event, if there's something more powerful than the 3B2/300 for software development at anything like the cost, I haven't seen it.

The 3B2/300 weighs about 30 pounds and is roughly the same size and shape as an IBM PC XT. Its innards are certainly no more complex than an XT's. If the introductory quantity one price is $9950, what will the quantity one hundred price be a year from now? Ditto with memory: that $2400/megabyte is quantity one today; I expect it to fall by half within two years.

Do They Know the Territory?

Every publication from computer magazines to the *Wall Street Journal* has speculated that AT&T knows a lot about computers but not a lot about marketing. How could The Phone Company learn that? This is, after all, the hated Ma Bell . . .

So, naturally, when I got a chance to interview John Scanlon, AT&T's vice-president of the Technology Division, even though it wasn't very original of me, I figured I'd get that one out of the way. "Great R&D," said I, "but can AT&T handle marketing?"

"We seem to have done a good job of creating a demand for UNIX," he said.

Which is true enough. Moreover, I notice that even IBM is supporting UNIX, both directly and through Intel, which is developing UNIX for the Intel iAPX286 chip.

"We already have UNIX for our machines. Just turn on the switch: it comes up in UNIX, with most of the features and utilities that programmers want. Who else can offer that at our prices?"

Maybe some others, particularly if you count UNIX clones such as UNOS from Charles River Data Systems, thought I, but I didn't want to argue with him.

"And we're not through. Right now a full UNIX system really needs 2 megabytes, but we're getting it smaller. We're 90 percent to getting UNIX tamed. After

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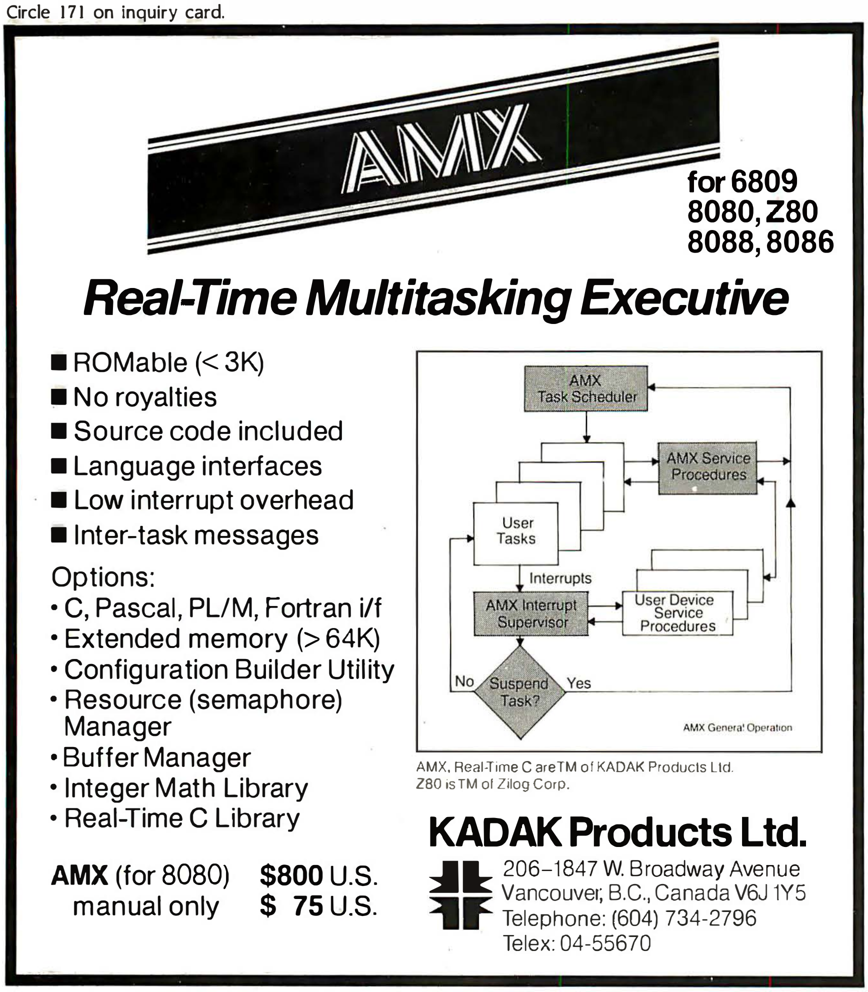
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all, we've used UNIX inside Bell for years to provide turnkey systems for our internal use. We do accounting, telephone control, and billing, and we can develop new UNIX shells for each application."

There's a lot to that. If some outside company had been supplying Ma Bell with office computers for accounting, billing, word processing, and all the mundane tasks one uses computers for, we'd think it a highly experienced company. AT&T has in fact been using a lot of its own equipment for years; it just didn't show elsewhere. The company's got more user-service experience than has usually been realized.

"But," I asked, "have you really tamed UNIX? It takes a UNIX wizard to keep the system going—at least it does everywhere I know."

"We have to get the size down," Scanlon told me. "At $4800 for 2 megabytes—and you need that now—UNIX is too expensive for the mass market. But we'll get it there, and when we do, we'll get it matched to silicon. Maybe in a few years we'll have UNIX on a chip."

Ridiculous, thought I.

Then I remembered where I was.

I was sitting in a carpeted office that looked much like an expensive executive suite. I'd reached it by going through expensively furnished lounge and reception areas. Of course; AT&T can afford lavish offices—except this wasn't any lavish office. This was in a bay of the Los Angeles Exposition Center. AT&T not only had the largest exhibit area I've ever seen at *any* computer show: the company had taken an even *larger* area, closed it to the public, and lavishly furnished it for the convenience of dealers, executives, and the press.

Out in the exhibit area were about 100—and I do not say this for exaggeration—young men and women in dark suits, the most neatly uniformed and well-groomed corps of show people in my memory. Many were extremely polite, with plenty of social skills, but they knew nothing whatever about computers.

If throwing money—or people—at a problem will solve it, AT&T will never have any difficulties. Of course, that doesn't often work—

But then it began to sink in. Along

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IBM PC/XT COMPATIBLE

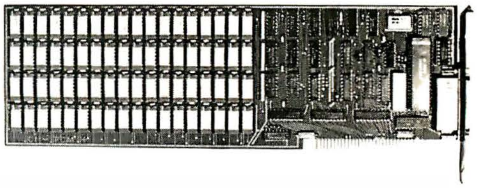
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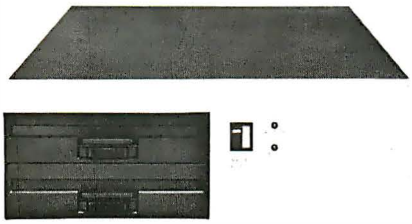
EMULATION RL02

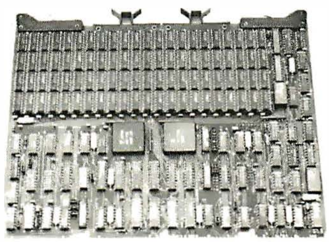
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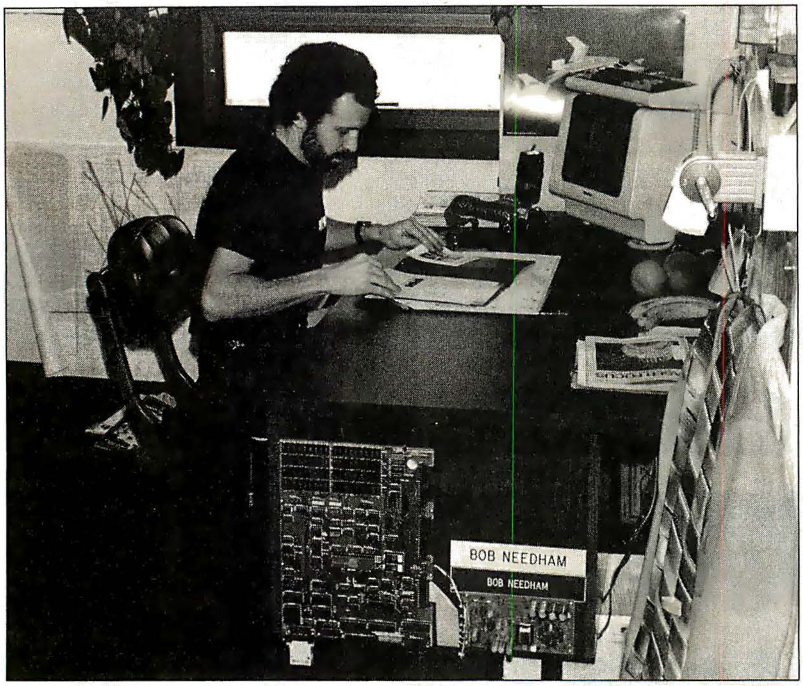
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The Unshippable Sage



In my judgment, Sage computers have about the same place in the world of the Motorola 68000 and follow-ons that CompuPro's boat anchor has in the Intel 8086 and beyond world: they're very probably the best systems you can get for software development; they certainly have a lot of bang for the buck.

The Sage is also useful as a general-purpose computer: there's getting to be a lot of good software, including engineering applications stuff, for 68000 systems. Sage uses a number of Sage computers internally for everything from accounting to new systems design; and therein hangs a tale.

When I visited Sage at the Reno headquarters I was shown through the whole plant, including the inner offices where new research is done. Sage's people use quite a lot of modern equipment, including some fascinating stuff for computer-assisted drafting and for chip design. I also saw the oddest computer I've ever seen in my life. I mean, I've seen plenty of desktop computers, but I never saw one bolted to the *side* of a desk before; yet there was a perfectly good Sage II in that situation (see photo 2). It was running, too. None of the Sage crew seemed to think that was odd at all. They were used to it. Finally, I had to ask.

It turns out that in the early days of Sage, when they first began to ship machines, they got more orders than they could fill; so that whenever Bob Needham, one of the cofounders (with Rod Coleman), would get a machine to help him with advanced system design, someone would see it and ship it off to a paying customer. Eventually Bob decided that enough was enough and bolted a new Sage II, sans case and fan, onto the side of his desk. The disk drives and power supply were in a drawer.

No one has shipped that one . . .

with all the well-scrubbed young women in stockings and heels and pinstripe suits and little neckties, and the young men in similar plumage—in among those were mixed real working software engineers and even a sprinkling of true wizards from Bell Labs. As a matter of fact, it was easy to spot the real hackers: the programmers all read BYTE and knew exactly who I was, while the press-relations people had never heard of me but tried to pretend that they had.

I don't have to ask if Bell Labs understands transistors. For reasons too complicated to explain, I have framed on my wall a dollar bill signed by Dr. William Shockley: it's a tiny part of the Nobel prize he received for inventing the transistor while he was at Bell Labs.

The Phone Company never did lack for scientists and engineers. AT&T won't have problems in that department. This is one of the few companies that plan for decades ahead.

If That's Not Enough

AT&T also has some brilliant management, beginning with Jack Scanlon, who understands this business pretty darned well. We sat in a lavish office suite surrounded by the trappings of corporate power: but Scanlon talks like any true hacker. He reminded me of a lot of the sharper micro people I know: there was that same breadth of knowledge about the field, familiarity with every intimate detail of his own product, obvious pride in the company's achievements.

He gets particularly excited about what can be done with silicon and the next generation of chips. "Every year we can double the number of transistors we can put on a chip. The guys who design those chips have to do something with all those transistors. We're seeing a whole new renaissance of silicon architecture. The difference between hardware and software is vanishing . . ."

And more. On software and computer languages: "Language is the wrong way to look at it. Move back a few steps. Watch that guy at his desk. What does he want the machine to do? He knows he can do more than one thing at a time. He has to worry about a lot of things at once. What I want is fundamental building blocks he can throw together fast. This guy wants spelling and maybe a spreadsheet, another fellow needs a database. Once we know the concepts, we don't have to worry about languages. We can even put them in silicon.

"Obviously, we're going to support the popular languages, C, and Pascal, and Ada, and Modula-2, but the real goal is to see what people want the machines to do for them."

That sounds a lot like marketing smarts to me.

Sure: AT&T will make marketing mistakes. The people there are used to figuring out what they think people

(continued)

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need and providing it whether it's wanted or not. It will take considerable effort to modify that attitude.

Consider: here AT&T spent more than I've ever seen *any* company spend at *any* computer show: this to bring products to a dinky little COMDEX that I wouldn't have bothered to go across town to see if AT&T hadn't been there. The press corps was the smallest for any show I've been to since the 70s. Having brought the 3B2 to the tiniest pond available, AT&T still didn't have a good mechanism for getting people to a press conference. The COMDEX staff were even telling people it had been canceled; if I didn't have a nasty, suspicious nature so that I checked with AT&T myself, I'd have missed it.

Just before COMDEX, I received three phone calls, two letters, and a telegram reminding me that I could have an interview with John Scanlon. When I discovered I was missing the press conference—it was in the Bonaventure Hotel, a mile from the show—an AT&T expediting officer put me in a cab to get me there. AT&T sure paid attention to press relations: but with what result? Apple spent *far* less to get Macintosh on the cover of every magazine in the country. I've yet to see real coverage of the AT&T market entry.

On the other hand, AT&T can afford to make mistakes. When I said that at AT&T's lavish press luncheon, some of the computer press people said, "Yeah, and they got started early."

Maybe; but that 3B2 is one heck of a machine. It's state of the art, and it's available *now*. Of course, it's not a retail system. AT&T intends just now to sell to system developers and value adders who'll package it into full systems that will inevitably cost quite a lot. Retailers needn't worry just yet.

However: where else can you get a UNIX development system that you can also use for your general-purpose computing at that price? And certainly The Phone Company knows how to build rugged, reliable equipment. I wonder what the 3B2/300 will cost next year?

Of course, we haven't heard the last from the micro world either. AT&T's machines are still positioned for maximum effect in the minicomputer world, and if AT&T has a year of development time to impact micros, so do first-class microcomputer outfits like Sage and CompuPro. The race isn't anywhere near decided.

Whatever happens, the micro industry had better think hard about AT&T's impact, which will be as big as IBM's. AT&T is big, is here to stay—and has got some damned impressive machinery.

Update: AT&T has also got some real marketing problems. It took me two days to find out the licensing fees for UNIX System V on 68000 systems, and when I finally did, I found the fee structure is set for minicomputers; the company doesn't know how to handle thousands of sales.

In fact, I found myself conducting a telephone seminar on the micro market. Maybe the people there learned something. More next time.

Big Mac

I've been sitting here bringing up MacWrite, and while swapping disks back and forth on my Macintosh, I thought about the contrast with the AT&T system and UNIX. It takes a couple of minutes to get the Macintosh ready to run a simple text editor; for me that's far too big a waste of time, especially when the only editor available is MacWrite.

In other words: I'm nowhere near as impressed with the Macintosh as everyone else seems to be.

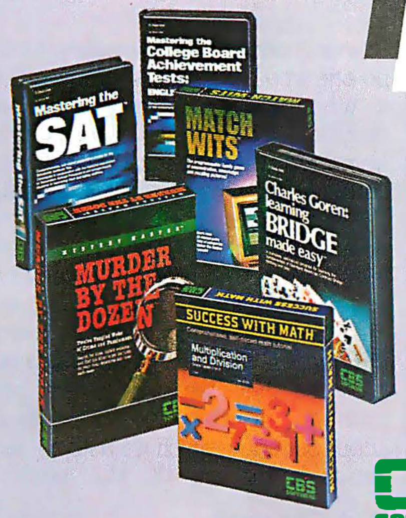
I know I'm in trouble for saying that. I've already experienced what happens when one is less than enthusiastic about Macintosh: the Mactribesmen descend in force with fire and sword. You must overlook all the Mac's faults, for after all, they're only temporary. Everything will be fixed . . .

If IBM or AT&T had come out with a machine that had a single disk drive, no Control or Escape keys, nonstandard interface between keyboard and system, proprietary operating system, limited memory, closed architecture with no possible access to the machine's innards, disk formats totally incompatible with anything else in the micro community, no languages except Microsoft BASIC (and plenty of bugs in *that*), and absolutely no application software, the micro community would have screamed bloody murder. Apple has done precisely that, and everyone applauds.

I'm sorry, but I don't. As I write this, the Macintosh is a wonderful toy; but it's not very much more.

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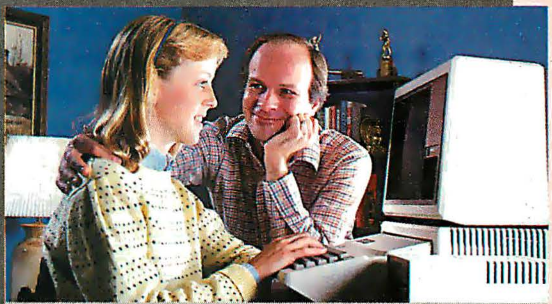
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Now, it certainly is fascinating. I know no one who has a Mac who wants to sell it. When it was my turn with the Mac that Dr. Hyson and I own between us, he parted with it reluctantly, and I can certainly see why. The machine is fun.

It just isn't very useful because there's no application software. Indeed, there's less than we thought, because Microsoft's Multiplan, which we bought with the Mac, is no longer being delivered; the dealers have just been told to take it off the shelf. We have not yet been told why or what Microsoft will do about our copy (which we paid full retail for, as we did with the Mac itself).

The Creator

In fact, the *only* application software for Mac that's actually on the market is Bruce Tonkin's The Creator database. The Creator is a kind of personal filing system, and there are versions for nearly every microcomputer I know of. The data files created by it can be transferred among all these systems—except, of course, for the Macintosh, which sits in lonely isolation.

For the price—$35 postpaid, 30-day money-back guarantee—The Creator is one of the best values in micro land. I recommend it for nearly any machine; but especially for the Macintosh, since it lets you do *something* useful with the machine.

The Macintosh version of The Creator is written in Microsoft BASIC. It doesn't use the Macmouse, because MacMicrosoftBASIC is too full of bugs to allow that. Instead, Bruce takes all input from the keyboard and formats it himself; of necessity, he has to treat the Mac as a glass Teletype, ignoring all its splendid Macfeatures such as Quickdraw, because there's no way to get at them.

Tonkin writes many of his programs in his PBASIC, which is a preprocessor for Microsoft BASIC that works somewhat as the RATFOR precompiler works for standard FORTRAN. PBASIC lets you do structured code and handles most of the housekeeping for you. I've reviewed it before, and I still recommend it; Bruce has written some impressive software in PBASIC. The output of the PBASIC "compiler" is legal Microsoft BASIC; you can then truly compile that with Microsoft's BASCOM to get tight, fast code that's very portable.

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Alas, though, it won't work on the Macintosh, because MacWrite won't let you build large enough source-code files to make it worth porting PBASIC over to the Mac.

For the Rest of Us?

I've lived in Hollywood for some years, and I've grown familiar with the typical Tinseltown deal. A producer goes to a star and says: "I've got a great script and your favorite director. Sure would like to have you in the picture." Then he goes to the director. "I've got a star and a script, and the star sure wants you—" Then to the writer; and finally to the money people. When it's all finished, everything he's said is retroactively true.

Similarly: Macintosh is going to sell like hotcakes because of all that wonderful application software. Now you can't do much with software on the Mac, because there's too little memory, and it takes anywhere from 5 to as many as *40* disk swaps to copy a Macdisk; but it's all right, because there will be a second disk drive, and a hard disk, and other excellent hardware after-market add-ons to fit on the Mac's "virtual slot"; and after that the software will be easy to write. Software houses are going to work very hard to write application software for the Mac because there's such a huge market, since Apple's selling an awful lot of Macs. Hardware houses will do Macadd-ons because there's so much software. Etc.

It can certainly be made into retroactive truth. By the time this comes out, I expect it will be. Some of those Hollywood deals fall flat, though: it all depends on how quickly they can be put together before everyone in the industry catches on. Meanwhile, right now the Mac is mostly useful for people with special requirements, such as advertising layouts with text or producing memos with graphics.

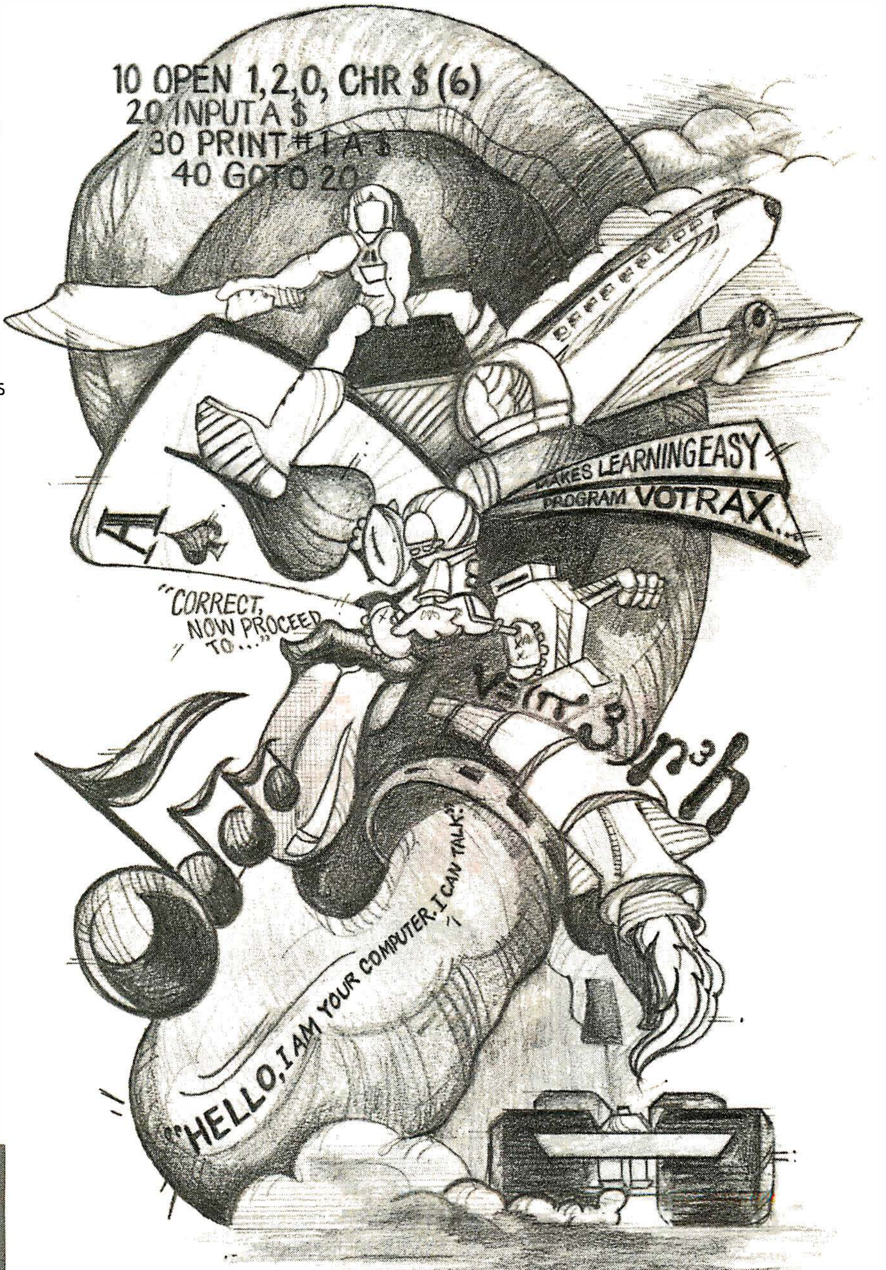
It sure is fun, though.

Cataloging

For some years now I've used Ward Christensen's public-domain disk-catalog program. Lately, though, I've been importuned to try a new one called Eureka! from Mendocino Software. Eureka! has a number of advantages, including the capability to include lots of comments in your disk catalog.

(continued)

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so that you can figure out that "NASTYLET.TXT" was sent to your mother-in-law rather than your lawyer, or whatever. It also lets you date things.

Until recently, though, I couldn't get Eureka! to work with my big CompuPro System 8/16, nor would it catalog the system's hard disk. The Mendocino people kept trying, though, and eventually sent their stuff to Tony Pietsch; and as of an hour ago Noor Singh delivered a copy with the note that this time it works.

It's about time I changed over, and the ability to add comments and dates makes Eureka! nearly irresistible. Full discussion next month, or Real Soon Now if too much flows into Chaos Manor in the next few weeks; meanwhile, Mendocino Software deserves some applause for plugging away until their people could make Eureka! work on my system. Thanks.

RAM Disk for the Z-100

Some weeks ago I got a letter from David James at the University of Kansas. Zenith offered the faculty and students at UK one of those deals you can't refuse, a Z-100 at a really good price, and Mr. James bought one with a lot of memory. When he went looking for a RAM-disk program, though, he couldn't find one.

I had my assistants send copies of his letter to half a dozen places known for their RAM disks. We got only two answers.

Zenith recommends Standard Data of Fort Lauderdale, Florida. I've not used this company's boards, which come in 256K-byte sizes, but I suppose the hardware and software must work or Zenith's people wouldn't have sent me Standard's address in reply to my inquiry.

I'd suppose that CompuPro's M-Drive/H boards could be made to work, since they're IEEE-696 (S-100) standard; but I've never heard of an installation program that would get M-Drive/H running under Z-DOS. Someone would have to hack up a BIOS (basic input/output system) for that, and I don't know of anyone who's done it.

One other source I know of is Macrotech out in the San Fernando Valley, which has a full 1-megabyte board for the Z-100. It's been going for six months now with RAM-disk software.

(continued)



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There's an "uh-oh" command called Undo. Make a mistake? Or just want to experiment? Hit Undo.



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Word travels fast.

Word has a Mouse, a handy little critter that lets you move copy, select commands and edit faster than you can say "cheese."



Word also lets you create your own style sheets, so you can standardize your documents, memos, files and letters.

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Late addition: we have one. It works fine. More next month.

EAT YOUR HEART OUT

Macrotech had an impressive board running at COMDEX Winter: an 8-bit Z80 coupled with an Intel iAPX286 chip for 16-/32-bit processing.

It was installed in a CompuPro boat-anchor box much like mine. I admitted that I was impressed. To make sure there were no misunderstandings, Macrotech's people opened the box to show me that the board was wire-wrapped; a production model will be available sometime this summer or fall.

The rest of the boards in the box were CompuPro. They claim that sometime before next fall's COMDEX they'll come over here, open my Dual Processor, remove the CompuPro 8085/8088 board, and insert a Macrotech board; after which my system will continue to operate on CP/M-8/16 as before, except that it will be faster, will be able to run Z80 as well as 8080 software, and will accept iAPX286 commands. We'll see; my CP/M-8/16 isn't the common variety, since Tony Pietsch did some work with the command processor, and enabled interrupts, and generally did a spit-and-polish job. On the other hand, I never throw anything away: I can certainly boot up the old standard CP/M-8/16 if I have to.

PRINTER OPTIMIZER

Last month I mentioned Applied Creative Technology's Printer Optimizer, which is a box full of memory that sits between the Golem (CompuPro 8/16) and the NEC 7710 Spinwriter. Shortly after that, ACT recalled the machine in order to add even more memory to it.

And I discovered that I was hooked. No sooner was the little jewel gone than I missed it terribly. It's amazing how you can get used to the idea that printing is something that happens nearly instantaneously (well, at 9600 bps, which is the speed at which the computer ships data into the Optimizer). Waiting for the machine to print at normal speed (1200 bps) was just no fun at all.

Ten days later it came back. The first time it showed up I'd had Alex install it, but he wouldn't be back from UCSD for a couple of days, and I wanted the Optimizer *now*; so I tackled the installation myself.

I am no hardware genius. Like most Americans of my generation, I learned to solder and install electrical switches and such, but when I was in school electronics meant vacuum tubes and hookup wire; not only didn't we have transistors, but printed-circuit boards were pretty rare. Thus, while I'm not afraid of the innards of my computers, I do tend to think of hardware jobs with a distinct sense of unease, not to say dismay. There was nothing for it, though; if I wanted my Optimizer—and I sure did—I was going to have to do it myself.

It turned out to be simple. Not as simple as it would have been had I wanted to connect it to a Centronics parallel port instead of through an RS-232C serial port, but simple enough. The ACT instructions are quite clear, with plenty of diagrams and examples and a good explanation of the theory of what's going on. It took me considerably less than an hour to hook things up, and mirabile dictu, everything worked first time.

Now, with 256K bytes of memory in the Optimizer, I can pack a great part of an entire novel into it. I can do that as one long file, or as a series of linked files, or even one file at a time if I want to fiddle with the last part while the beginning is printing out.

The Optimizer even has a way to program it so that the files aren't necessarily printed in the order you put them in: there's a way to shunt stuff off, as on a railway siding, so that something else can be printed first. It's not a feature I use very often, but it can be convenient, as for example when you don't have the fanfold tractor on because you want to print single sheets, but there's a convenient opportunity to load in a file that will need fanfold.

If you don't have a printer buffer, you don't know what you're missing. They come in a variety of styles with various features, and I haven't much experience with any of them except the ACT Optimizer. I sure love this one, and it's hard to imagine one easier to use. Given the wide variety of protocols and stop bits and other such stuff (the RS-232C, meaning Revised Standard-232C, is anything *but* standard; there are a bewildering complexity of ways to hook serial ports to computers), it would be difficult to write better hookup instructions.

Recommended.

SPEEDING UP YOUR PC

Another gadget I'd just got installed last month was the Quickon from Security Micro Systems. This little gizmo installs rather simply in your IBM PC; when it's all aboard, all you'll see is a small switch on the back.

Throw the switch one way, and the PC behaves normally. Throw it the other way, and the memory tests are disabled: the PC comes on nearly instantly. Now, I don't think you ought permanently to disable the memory tests; but I sure don't much care to wait for all that every time I have to turn the PC off to escape from some hang-up—and with no true hardware reset on the machine, that happens more often than I like.

We've had the Quickon working for five weeks now, with zero trouble; and Jim Baen reports that he's had his almost a year. If you like waiting for the PC, you won't need this, but if you're as impatient as I am you'll find it nearly indispensable.

DISK MAKER

New Generation Systems is a public benefactor.

Our Kaypro 4 will, courtesy of a program called Uniform—itself a lifesaver—read a number of 5¼-inch disk formats, but there are machines it has never heard of. However, when we get a disk that the Kaypro can't read, we no longer despair; we take it to the Disk Maker I.

I first heard about the Disk Maker at CP/M East when I stopped to talk with Leor Zolman. Leor was, naturally, demonstrating BDS C, the blindingly fast 8-bit C compiler he wrote while he was still an undergraduate at MIT; but he'd been so impressed by the Disk Maker that, although he owned no part of the company that makes it, he had one to show off at his BDS booth.

That was a pretty good recommendation by itself. I have considerable confidence in Leor's judgment. He introduced me to the box's inventor, and we arranged to get one shipped to Chaos Manor. The result has been as advertised. Disk Maker can read almost any conceivable 5¼-inch disk format.

The machine consists of one or two disk drives—mine has two, one 48 tracks per inch (tpi) like the IBM PC, the other 96 tpi like the Eagle 1600 series—and an S-100-bus disk-controller card. You

(continued)

ITEMS DISCUSSED

AT&T/IBM PC Interface . . . . NA
Locus
3330 Ocean Park Blvd.
Santa Monica, CA 90405
(213) 452-2435

Calendar/1 . . . . NA
Clear Systems
607 Ashland Ave., Suite A
Santa Monica, CA 90401
(213) 394-7740

CompuPro 8/16 System $5995
CompuPro
3506 Breakwater Court
Hayward, CA 94545
(415) 786-0909

Disk Maker I $1500
96 tpi option $385
New Generation Systems Inc.
1800 Michael Faraday Dr., Suite 206
Reston, VA 22090
(703) 471-5598

Enchanter $49.95
Sorcerer $49.95
Infocom Inc.
55 Wheeler St.
Cambridge, MA 02138
(617) 492-1031

Eureka! $50
Mendocino Software
POB 1564
Willits, CA 95490
(707) 459-9130

Macintosh $2495
Apple Computer
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

PBASIC $39.95
The Creator $35
TNT Software
34069 Hainesville Rd.
Round Lake, IL 60073
(312) 223-0832

Printer Optimizer $499
Applied Creative Technology Inc.
2156 West Northwest Hwy., Suite 303
Dallas, TX 75220
(214) 556-2916

Quickon $69.95
Security Microsystems Consultants
16 Flagg Place
Staten Island, NY 10304
(212) 667-1019

RAM Disk for Z-100 . . . . $995
Standard Data Corp.
1500 NW 62nd St., Suite 508
Fort Lauderdale, FL 33309
(800) 327-5567

RAM Disk for Z-100 . . #896Z $2250
Z80/286 Processor
Board . . . . MI 286 $1395
Macrotech International Corp.
9551 Irondale Ave.
Chatsworth, CA 91311
(818) 700-1501

Sage II $3900
Sage IV $7300
Sage Computers
4905 Energy Way
Reno, NV 89502
(702) 322-6868

3B2/300 Computer $9950
AT&T
222 Broadway
New York, NY 10038
(212) 669-2584

can install the Disk Maker card in your S-100 system and forget it's there until you need it; then, when you get a disk with a strange format, fire up the Disk Maker. Chances are very good that it will be able to read it, and you can use PIP to move files to and from your normal system's disks.

We have the Disk Maker installed in Zorro, the Zenith Z-100, who also runs 8-inch disks in addition to his normal 5¼-inch disks; thus, we can move files from any 5¼-inch format to 8-inch IBM standard, after which they can be brought in for Zeke and the Golem.

The Disk Maker will format disks, too; about 50 formats are supported. It's thus nearly ideal for a small software house that tries to support a wide spectrum of customers.

It's easy to install, easy to use, and darned near unique. If you need one, you need it bad.

Raving About Calendar/1

Peter Flynn, our new assistant, sees a *lot* of software; alas, more than I do, since so much flows through Chaos Manor that I have to let Peter and Alex screen it unless it's something I'm particularly interested in. Thus, he doesn't give many rave reviews.

Here's one item he liked a lot.

"Calendar/1 puts date-related information into a calendar format. It is easy to use. The manual is good and organized in a straightforward manner. The preface states that the manual assumes you know how to use the various CP/M functions such as PIP and COPY and that you have and can use a text editor that can produce plain text files 'with no embedded control characters.'

"The text editor is used to create one or more files that are the sources for the date-related information. This is the best approach I have ever seen for a calendar program; it is easy to input large numbers of notices, and it's very easy to update and modify into different calendars. This is by far the most useful and versatile program of its type I have ever seen. It is much better than the scheduler in Valdocs.

"Calendars are composed of notices that are stored in calendar files. Each calendar file is composed of dates followed by notices pertaining to that date. The calendar files, which you create on a word processor, look like this:

```
%This is a comment.
@ 8/10/84
Meeting with Fred at 7:15 AM

7/29
First Moon Landing, 1969

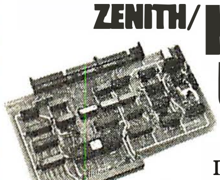
8/10
Sally's Birthday
```

"The order of the dates does not matter, and you can enter the same date more than once. They can be organized under headings such as birthdays, meetings, notices, and social events. Under each date is a notice or group of notices. They will be printed in the box for the corresponding date on the calendar. Lines beginning with % are comments and are ignored by the Calendar/1 program.

"A new calendar file can be for a month, a year, or many years. If a date

(continued)





ends in a year, such as 5/16/84, then it will be printed only in that year; if only a month and day are given, it prints the notice for every year. (Years can range between 1583 and 9999; if only two digits are given, the twentieth century is presumed.)

"Calendar files can be separated or combined: you can have a file of birthdays and another of meetings, print a calendar for each, and combine those with others to make one master calendar. Calendar/I comes with a number of prewritten calendar files, including holidays and historical dates of interest.

"Calendars can be printed on screen or the printer. You specify the length and width. If a notice won't fit, what will fit is printed, an asterisk is added, and the balance is printed as a note on an overflow page. The layout's good considering the space you have to work with.

"There are a number of other control features, all well documented.

"Calendar/I is useful for scheduling work; many people can be given identical copies for job control; it is also useful for travel scheduling."

We expect to make a lot of use of Calendar/I here at Chaos Manor. It's a well-conceived and useful program.

Out of Space Again . . .

There's a ton of stuff on my list, and I'm out of space. At least let me mention the Infocom games, such as Sorcerer and Enchanter and the like. Not only do we at Chaos Manor love them, but I notice that my partner Larry Niven is hooked. For those few who don't know, Infocom games are script driven: there's no fancy graphics, no arcade action; only text adventures.

This kind of game grew out of the original Crowther and Woods Adventure of the Colossal Cave. The original Infocom implementers worked on Zork while at MIT; they later developed other software for role-playing games. Some of the work they've done parsing and interpreting English is remarkable.

Enough. My taxes are due, after which I'm on the road for two weeks; meanwhile, I just opened a letter from Judy-Lynne Del Rey, my long-suffering editor at Ballantine Books; she's expecting Larry and me to turn in *Footfall* Right Away: the letter said only, "Nag! Nag! Nag!"

I think that was a hint. ■



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C·H·A·O·S M·A·N·O·R M·A·I·L

Licensing Agreements

Dear Jerry,

Because you occasionally address software licenses and their idiosyncrasies in your column, I thought you might be interested in my company's experience with one software manufacturer—Sunburst Software.

In August 1983 we ordered an accounting package as ported to a Charles River Data Systems Universe computer. The software had a myriad of problems, not the least of which was inaccurate addition of account balances. After many frustrating months we requested a refund of our purchase price. Sunburst declined our refund on the grounds that its license did not guarantee "suitability." I would like to see the accounting environment in which 2 plus 2 equaling 5 was suitable.

Incidentally, we think the CRDS Universe is a lot of lightning in a little box. We were running multitasking benchmarks and wanted to keep the processor working hard in the background while we tested throughput in the foreground. To exercise the processor, we were using the C version of BYTE's Sieve of Eratosthenes prime-number program, but we discovered that finding the primes between 1 and 10,000 ten times required so little time as to be insignificant. Instead, we had the CRDS pick out the primes up to 200,000 ten times, which it does in less than 100 seconds real time. Not bad.

Ralph Tilney
Austin, TX

Firms that give refunds on software report they don't have very many requests for same; possibly because such outfits take a bit more care?

My son Alex is a real fan of the Charles River Data Systems machines. They're a little out of the normal BYTE reader's price range, though.

I don't think the "BYTE Benchmark" is of much use any longer, though; aren't most compilers designed to optimize the Sieve of Eratosthenes? That's one reason I like "my" matrix benchmark; it's processor intensive and does "normal" arithmetic operations in tight loops.—Jerry

Electrostatic Printers

Dear Jerry,

I enjoyed your comments on the nonavailability of low-cost laser printers for the microcomputer industry (March, page 354). Having just completed a search for low-cost, high-speed printers, I can add some information. I am only a consultant, however, so I do not underwrite any of these products.

As regards the Canon LPB-PC, although it is true that this device can sell for about $4000 to an end user, the fact is that Canon has elected to sell the device through dealers and systems integrators who have to add the proper interface. The companies that market it have decided that the biggest market is for complex graphics printing where special typefaces and pictures are being drawn. By the time the user pays for the interface, it is a $10,000 printer. When I spoke to Imagen, it wasn't interested in developing an interface to emulate a daisy-wheel printer (or similar interface).

My client wanted to replace 60 dot-matrix printers with these Canon units, but no one seems to think that the plain printer market is very big. Why can't the printer manufacturers understand that most of the printing being done is straight alphanumerics with serial interfaces? Our reason for wanting the Canon system was that since the entire printing mechanism is in the cartridge, we could have an operator replace it instead of calling an engineer. If replacing the cartridge cures the problem, we save a $150 service call. The cartridge is presently $40, with projections to drop to $20 with competition.

You should refer to this market as electrostatic printers because they do not always use lasers. The Philips Elpho-20 uses a cathode-ray tube to transfer a blue image to the drum through a lens. This printer does 20 pages per minute and sells for $10,000 to the end user. Philips claims that the red lasers used in other printers are the hardest colors to sensitize the drum. The drum is most sensitive in blue, so it uses a CRT beamed through a lens. This technique increases the life of the drum and eliminates the moving mirror used to scan the laser across the drum.

I enjoy reading your column each month. Please keep up the good work.

Bob Noakes
San Francisco, CA

Eventually someone will become wise, if not with the Canon then with a Xerox or other brand; there are just too many computer users who've tired of having a machine gun in the same room with them. The laser—or electrostatic—printer is obviously part of the wave of the future, and one day we'll be able to replace both the office copier and the printer with one device.

Until then I'll have to limp along with my Spinwriter for submission copy and the Printmate for fast dot-matrix copy. Thanks for the kind words.—Jerry

Illegal Copying

Dear Jerry,

We at H & H Scientific have recently introduced our Stock Option Analysis Program (SOAP) for the IBM PC and are using a new method to deter illegal copying that might interest your readers.

Whereas the Apple version of SOAP had been copy protected, the IBM version of SOAP is issued in an unprotected format and can be copied subject to the terms of our standard licensing agreement. However, in order to use the Dow Jones News/Retrieval Service and thus take full advantage of all the features of SOAP, the original program disk must be returned to us to have the purchaser's Dow Jones password encrypted onto the disk. This becomes a permanent part of the program disk and any copies will carry the password.

We think that few purchasers will be willing to give a copy of a program containing their password to a friend and thus risk incurring even modest usage charges by their friends. In effect, the user's password is held hostage (by the user) to guarantee the security of the personal program.

We think this will prove to be an effective deterrent to the problem of illegal copying and at the same time will give the legitimate user the maximum flexibility in selecting the optimum hardware environment, i.e., using SOAP with a hard disk, electronic disk, or combination thereof.

Hersch Pilloff
Fort Washington, MD

You have a novel approach to the piracy problem. I can see one difficulty: many users are likely to be wary of giving anyone, including software vendors, their passwords.—Jerry

Turbo Caution

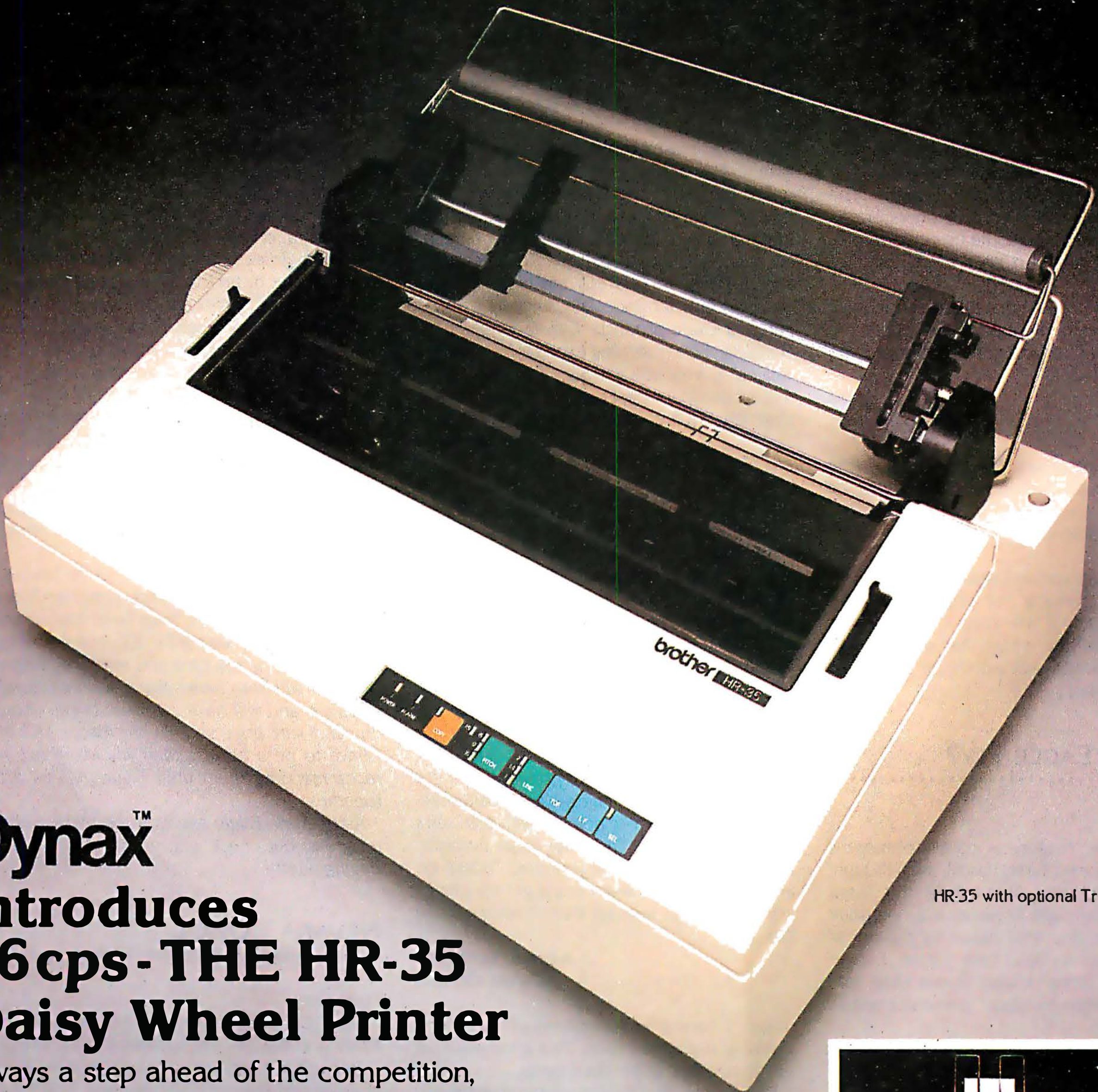
Dear Jerry,

I am sure that the nitpickers will find problems with Turbo Pascal, but the program compiled your matrix program from the October 1982 BYTE with no complaints. The execution time was about 20 seconds. The compilation time was about 6 seconds. These times look very respectable to me.

I caution anyone installing this language to carefully check the definitions for the available terminals. The definitions supplied for the Osborne I were incorrect in two places. How-

(continued)

FRONTRUNNER



HR-35 with optional Tractor Feeder

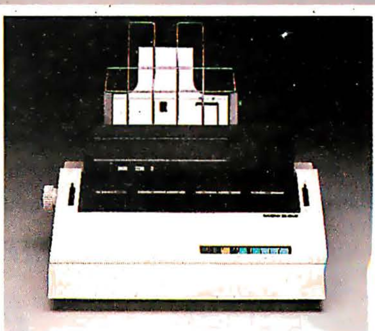
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ever, the Installation Appendix clearly states what is required to install a terminal. Thirty terminals are listed.

The two required changes were in the cursor positioning code: Borland International had the X and Y positioning order reversed, and the Erase to End Of Line code was actually Insert Character code. With these two changes, all test programs compiled and ran correctly. The spreadsheet demonstration program operated correctly and provided some useful examples of procedures that can be applied to other programs.

For the price, I believe that this is an adequate implementation of Pascal for the beginning user. I hope that Borland continues to provide a quality product.

LEO F. HOOD
West Lawn, PA

I have many good reports about Turbo Pascal, and those are certainly respectable times for an Osborne 1. I'm all for Borland; I hope other software companies decide to lower their prices, too.

Borland has an updated version of Turbo; you can get it by sending the original disk and $29.95 (or buying a new copy, of course). It's worth the trade: the update has overlays and is very fast. There's source code for some nice utilities, too.—Jerry

CAN THE EAGLE FLY?

Dear Jerry,

I write for two reasons. A couple of months ago you mentioned Turbo Pascal, and I thought I would let you know what I think of it. What do I think? It's all right. However, floating point is slow. Slower than IBM Pascal by a factor of 8 to 10 is what my tests have shown. Integer arithmetic in Turbo is also slower than IBM Pascal's but only by about one-and-one-half times.

On the other hand, Turbo's screen I/O seems to be faster. Turbo also has some nifty screen-manipulation commands, but any shot at source-code portability is then lost. I see Turbo as a nice development compiler because it compiles so quickly. As long as you are sure to write in plain Pascal, Turbo can be used for development and debugging. The source can then be compiled with the IBM compiler for the final product.

My other reason for writing is this: I actually own an Eagle PC-2, not an IBM PC. The PC-2, unlike the 1600 series, strives to emulate the IBM as much as it can. It does an acceptable job in my opinion, but things could be better. As you have observed, the documentation stinks. Trying to find out anything from the dealer is difficult, especially since he stopped carrying Eagle products. Calling Eagle in Los Gatos can be a frustrating experience. "Call your dealer," is what you get. Sigh. Do you know of a users group for the Eagle PC? I would appreciate any tidbit of information you might have.

PETER KLINE
Providence, RI

Dear Jerry,

You often refer to your Eagle 1600-series system with a great deal of enthusiasm, and I have visited the local dealer for a first look. However, Tom Wadlow ("The Eagle PC," March, page 236) is rather lukewarm in his praise. I can only assume that he must base his judgment on a rather short exposure to the Eagle, whereas you have had yours for some time. Do you have any comments?

I would buy a 5- or 10-megabyte hard disk with backup tape but might prefer Microsoft's Word or Rocky Mountain's NewWord/MergePrint to the Eaglewriter, possibly with SoftCraft's Fancy Font system. The latter looks fantastic, and I have called for the promised "actual example." I only wish that I could get my system with the Corvus monitor that I have seen and like a lot.

ARNE R. LINDGREN
Culver City, CA

Sigh. I have mixed emotions about recommending Eagle computers. It's a good machine, but it sure has lousy documents.

Eagle's new documentation specialist keeps calling me to ask what I'd like to see in the updates; I keep hoping the company will get them done and ship retrofits. I love that Eagle, but I have to warn people: if you don't know a good bit about computers, be sure the updated documents are out before buying one of the 1600-series machines. I've had no complaints about the Eagle from experienced computer people, but there have been wails from beginners, all with problems that would have been trivial had there been better technical documentation.

In the middle of the rush to new documents, Eagle was hit by an IBM lawsuit requiring it to stop selling machines until it changed the ROM chips; as I write this, Eagle has announced that's done and it's shipping machines again, but its stock has fallen to a critically low value.

That's what delayed the update to DOS 2.0 as well. I received a test version of the 2.0 update, but then I was warned not to use it: I should wait for a later version. It's been a couple of months, and the upgrade hasn't come. Without DOS 2.0 with its tree structure, a lot of the value of the hard disk is lost. Eagle promises the new one Real Soon Now.

It's a real pity: Eagle has some of the best PC hardware around, and the 1600 compiles Turbo Pascal like nothing you have ever, ever seen. (It's fairly speedy with MT+, too, compared to the IBM PC.) By the time you read this, Eagle swears it will have better documents, updated software, and will have survived its cash flow crunch. I sure hope so. I like the machines, but I have to be a bit less than wholehearted in recommending them until Eagle gets its act together.

As of April, Eagle seems to be making real progress; but check with your dealer before buying.—Jerry

NEVADA COBOL

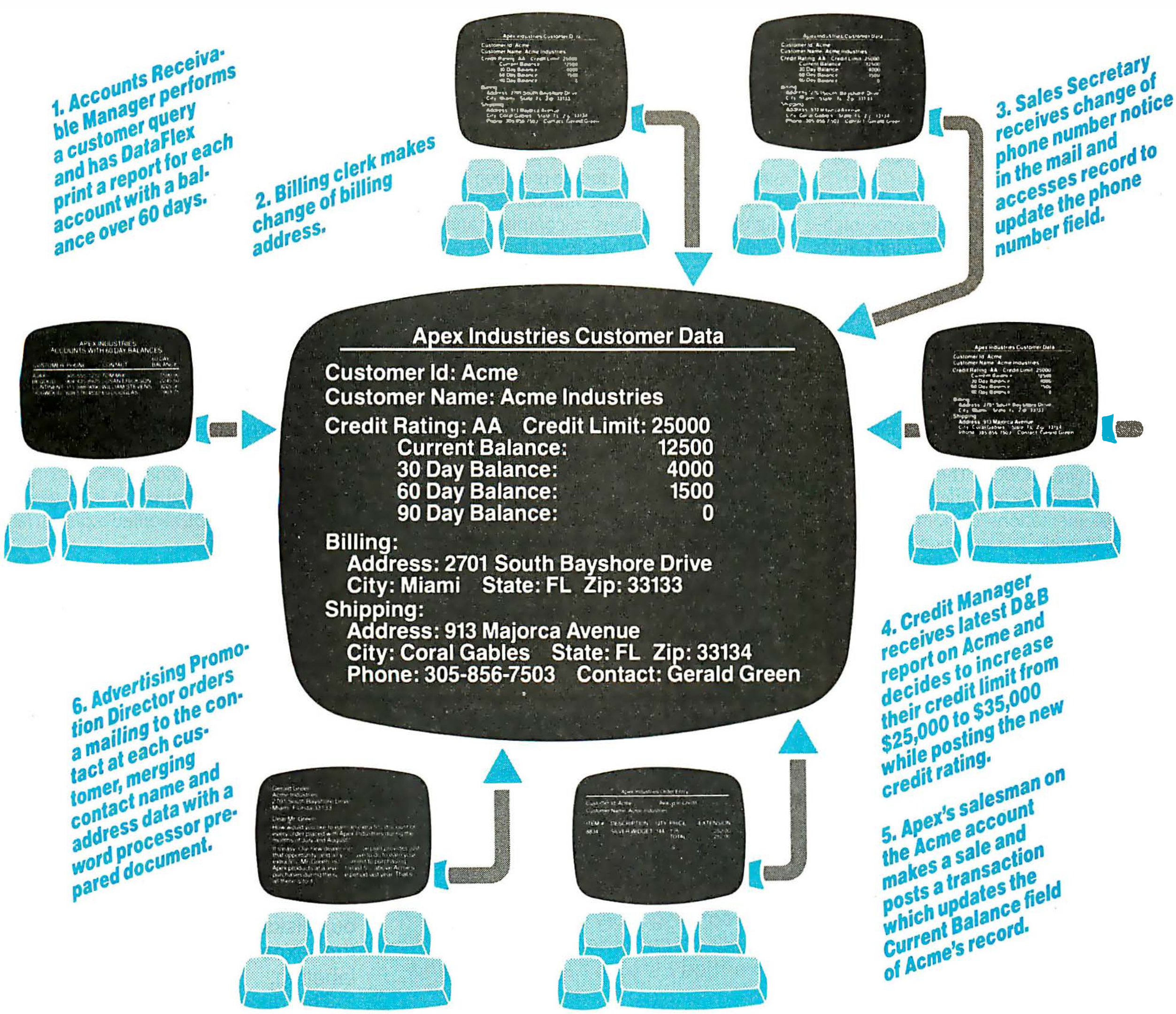
Dear Jerry,

John DaMassa asked about the $29.95 Nevada compilers and utilities in your March "User to User" column. I teach programming courses and use my Z80-equipped Apple II+

(continued)

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for demonstrations and examples. I bought the Nevada COBOL compiler about a year ago and have since added Nevada EDIT, FORTRAN, and PILOT to my program library. I also have JRT Pascal for comparison. I feel that I got my money's worth, but that's only one measure. For my purposes, I was also concerned about shortcomings of these packages and how they compared with standard language specifications and other implementations.

The COBOL compiler is a subset of the 1974 ANSI standard. It doesn't include some high-level modules described in the standard, such as the Table Handling and Sort features; some minicomputer COBOL compilers also don't have these. The language nucleus is complete, and subroutines in COBOL as well as assembly language are allowed. Documentation consists of a reference manual that adequately describes the language and how to get started. The user who doesn't know the language should buy a good textbook, such as Tyler Welburn's *Structured COBOL*. The negatives are minor: nonstandard 4-digit line numbers and minimal implementations of some I/O statements. For arithmetic, I'd much prefer the COMPUTE statement to the ADD, SUBTRACT, MULTIPLY, and DIVIDE verbs that are included.

The FORTRAN compiler would be the greatest bargain in microcomputer software if it were based on the 1977 FORTRAN standard. It is a very good FORTRAN IV implementation and does include the IF. . .THEN . . . ELSE statement from the 1977 standard. A good selection of built-in functions are included, plus a number of subroutines that interface with CP/M. The compiler doesn't include character class data, which is another desirable 1977 feature. The 8-bit implementation can cause surprises: single-precision and double-precision variables have exactly the same number of significant digits. The manual is a complete and well-written reference. If you're not familiar with the language, you'll also need a good textbook.

Nevada EDIT may not be the best program editor around, but it's probably the best full-screen editor in the low-priced field. It's compatible with any editable CP/M file type. I use it with JRT Pascal files as well as Nevada COBOL and FORTRAN. Since it's a full-screen editor, the user can edit lines in place and move anywhere on the screen. On the negative side, the control codes are rather clumsy. A number of editing commands require two steps: Control-V followed by another command code. I haven't been able to get a couple of the control codes to work. Some control codes must be changed to suit specific hardware environments (such as the Apple with CP/M) by using a configuration routine that comes with the editor.

You'll note that I haven't said anything about benchmark results. As a computer science teacher, I'm more interested in completeness of features than in object-code efficiency. Besides: have you ever tried to write the Sieve of Eratosthenes in COBOL?

JIM ARCHIBALD
Geneseo, NY

Dear Jerry,

I have tried Nevada COBOL, and the experience was dismal. I would *not* recommend the product to anyone. It is a pseudocompiler, creating p-code that is then interpreted by the Nevada run-time program. I bought it because I am a COBOL programmer on IBM mainframes and wanted to see how this microcomputer compiler stacked up. I performed a number of tests and was severely disappointed.

The Sieve of Eratosthenes benchmark took 7 minutes to run (one iteration) as opposed to 4 minutes in Microsoft BASIC and 3.6 seconds in Pascal MT+. Since one reason you put up with the tedium of compiling is to get faster code, Nevada COBOL seemed a dismal failure in this department.

I wrote a simple file-to-file transfer and discovered that it transferred all but the last line of the file. A bug is revealed in the way it detects

(continued)

an "at end" condition.

I wrote a program to test the way it handled arithmetic with the various COBOL numeric data types and discovered a bug in handling IF-tests. The code in question follows:

```
IF AMT-4 IS GREATER THAN AMT-5
  DIVIDE AMT-5 INTO AMT-4
    GIVING AMT-6 ROUNDED
ELSE
  DIVIDE AMT-4 INTO AMT-5
    GIVING AMT-6 ROUNDED
```

When AMT-4 was 5 and AMT-5 was 25, the result returned in AMT-6 was 5, which is correct. When AMT-4 was 25 and AMT-5 was 5, however, the result returned in AMT-6 was 0.20. No matter what values I assigned to AMT-4 and AMT-5, it was always the instruction after the ELSE that executed.

I called these bugs to the attention of Ellis Computing and sent source code and all, but Ellis never responded. May I respectfully suggest that you amend your remarks, at least regarding the COBOL package?

William Meacham
Austin, TX

Thanks for the reports. My problem is that I'm not about to evaluate Nevada COBOL; it's not a language I do anything with, and I'm not about to learn it. I can only report what I'm told.

Of course, I don't recommend COBOL in the first place. Edsger Dijkstra, the Netherlands computer philosopher, once said that teaching COBOL ought to be regarded as a criminal offense. I don't necessarily agree, but I know people who do. As to writing the Sieve of Eratosthenes in COBOL, I'd rather have an appendectomy if it's all the same with you.—Jerry

Copy Protection

Dear Jerry,

I fully support your stand against copy protection in software. It is bad for a number of reasons, and you have done a great deal for users in putting them forward. Some additional reasons need exposition.

One of the most significant things that copy protection does to software is that it alters the nature of the product. If I buy a piece of software, it is mine to keep as long as I own my system—provided it is not protected. If it is protected, then I have bought an entirely different product, a perishable one.

Copy protection also makes little sense economically to the manufacturer because the shelf-life expectancy of most software is too short for there to be much to protect. The company making the software may go out of business before piracy eats into its profits.

I am trying to buy several copies of my favorite word-processing program because it is being taken off the market, and I don't want to learn a new system or transcribe files. I am going to get four separate copies and hope.

Edward Swaim
Austin, TX

I hadn't thought of it that way, but you're right: copy protection makes a perishable good out of a durable good. I do have some sympathy for publishers, but I think the only real solution to software piracy is for the customer base to become sufficiently large. Then publishers can make a profit selling at such low prices that it isn't worth pirating the software.

Of course, high price plus piracy is the equivalent of a low average price, except that the publisher has fewer legitimate customers to support.—Jerry

Dear Jerry,

I've been reading with considerable interest your views on copy protection of software. Until

(continued)

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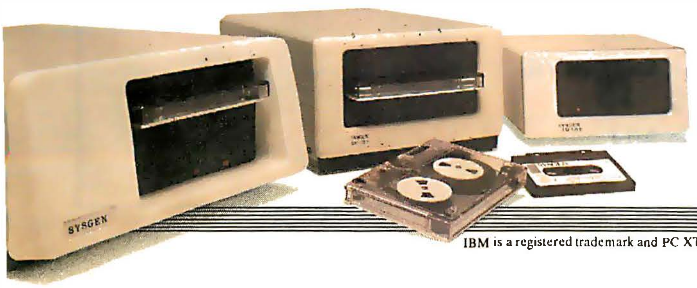
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recently, however, it was of only passing interest to me, having purchased an Osborne Executive, which has no such silly schemes. The Executive was then sold, a Macintosh bought, and along with it a copy of Multiplan.

Multiplan has a ridiculous copy-protection scheme. Microsoft supplies one master disk that it says the user can copy to save wear and tear on the master. However, in order to be able to use the copy, the user first has to insert the master disk, which apparently has a code that tells the copy it's okay to start working. Then you eject the master, put in the copy, and you're free to continue. As long as you don't turn off the power after inserting the master, the copy can still be used, no matter how many other applications you use in between.

This is my first exposure to copy protection, and I'm angry. Now I have to worry about two application disks instead of one, and if the one master disk is damaged, I'm out of luck until I can get a replacement. What *really* strips my threads is that a friend just bought a Model 4P from Tandy, also with Multiplan, and there's no copy protection at all on his version of the program!

So what gives? Does Microsoft feel that Macintosh owners are more prone to a little unauthorized profit than Tandy owners? Is this what I have to look forward to from Microsoft? It could at least provide two masters, à la Lotus 1-2-3. Anyway, I wrote Microsoft, asking for a second master, but I haven't gotten an answer yet. If this is common to the rest of its Macintosh programs, I think I'll hold off buying Word and make do with short letters using MacWrite. I'll let you know what happens; maybe Microsoft will listen to you.

RICHARD B. THOMAS
Tacoma, WA

I have terribly mixed Macfeelings about the Macintosh. At the moment there's so little software for it, and because there's only one drive, it's so hard to copy a disk (about 40 disk swaps for a complete copy, and God help you if you get confused in the middle of doing it) that I can't think the machine more than a pretty expensive toy; certainly it's not much use in business.

Of course, that could change when a second drive becomes available (I wonder at what price?) and all this software is actually published. Alas, if the Microsoft copy protection becomes standard for all business software, Macintosh will remain Macuseless for business; I sure wouldn't bet my career that one of those small disks was eternal.—Jerry

PROBLEMS WITH OTRONA

Dear Jerry,

I bought an Otrona Attache last year, partly because of your enthusiastic comments. Indeed, it is a fine 8-bit machine, probably the best CP/M machine available. Several months ago, I had the machine upgraded to become "IBM compatible."

Otrona claims that the machine will run nearly all IBM programs, but many programs will not run. It seems to be impossible to tell whether a program will work or not, as Otrona apparently hasn't tested many of them. For example, I have tried to find a good word processor. Microsoft Word will not run; PC-Write will not run; Multimate appears to run, but parts are exceedingly slow; WordStar will run but again very slow, much slower than the CP/M version.

BASIC is the most common language used with IBM computers, and it comes with PC-DOS and most versions of MS-DOS. No BASIC comes with the Otrona MS-DOS, and IBM and Compaq versions will not run. Furthermore, compiled BASIC programs will not run on the Otrona. Otrona says that it will have a BASIC interpreter "soon"; I haven't been able to find out what it will cost.

The Otrona 8:16 is *not* very IBM compatible. As an upgrade for existing Attache owners, the MS-DOS system has marginal value, although frustration should be considered part of the price.

Getting any answers out of Otrona is difficult. The company answers few letters, and I no longer can get hold of anyone there by phone.

Another quick point. The Turbo Pascal compiler is fantastic. The IBM version does run on the Otrona, and it is fast and easy to use. And the price is reasonable.

HARVEY MOTULSKY
La Jolla, CA

Adeline, our Otrona, recently returned from the "upgrade"; I wish I hadn't sent her in. Something was done to the screen intensity and contrast, so that the software brightness controls will no longer eliminate flash lines and such. In addition, as you say, many IBM PC programs will not run, and some are slower than the corresponding programs on the Z80.

I do not recommend the 8086 conversion for the Otrona. On the other hand, it remains the BMW of the 8-bit small machines. We have the large amber screen, which we like a lot, and the hard disk. With those additions, the Otrona is an excellent base station; leave them behind and you have a true portable. There is, after all, a lot of Z80 software (including my favorite editor, WRITE). The Otrona Attache is still the machine I carry on all my trips.—Jerry

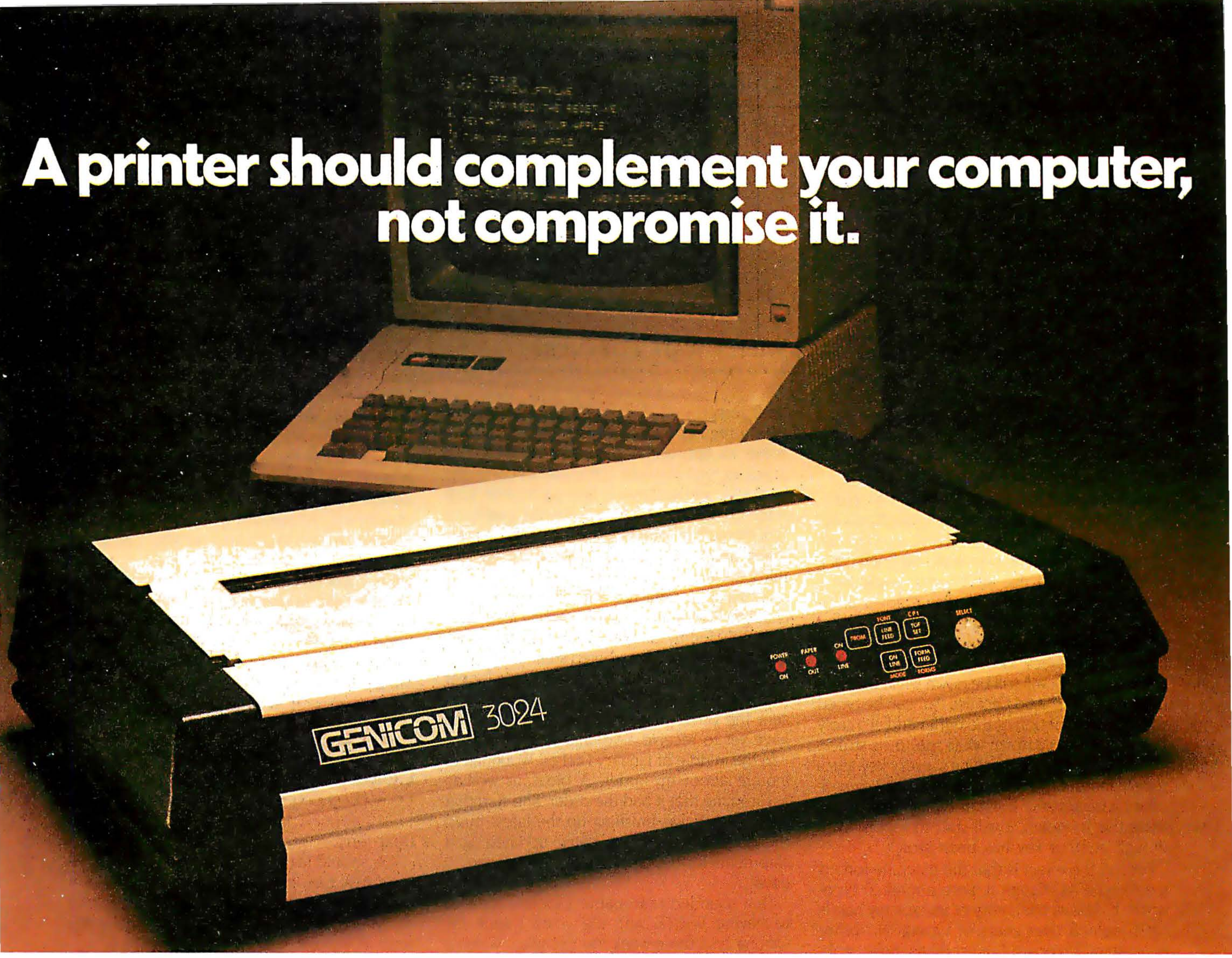
AGAIN, OTRONA

Dear Jerry,

Your continuing fondness for your Otrona Attache, along with my positive first impressions

(continued)

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of the machine at a show when it was first introduced some years back, made it an easy choice when it was time to replace my S-100 system with something more portable (I write everywhere), 16-bit (and the 8:16 meant I could cling to the 8-bit software I love while making a transition to the 16-bit world), and at least as reliable.

I was disappointed and returned the machine. Here's why.

The Attache keyboard has a nasty characteristic that makes it impossible for the machine to register any keypress while another key is still down or partially depressed.

At first glance this may not seem a problem, and certainly it hasn't affected your affinity for the machine. But I'm a fast typist, and though I learned on manual equipment, I've been using electric or electronic keyboards since 1961. Electronic keyboards with n-key rollover allow you to go into really high gear when typing familiar combinations such as "tion" and "ing." In the fastest execution of "tion," it's likely that the left-hand "t" will still be down while the right hand hits the "i." And because "io" can be typed with a rolling motion of the right hand, it's likely the "i" will still be down while the "o" is struck.

Furthermore, the machine's every-key-auto-repeat feature interacts with this one-key-at-a-time characteristic. If when typing "tion," you leave the "t" down, it will start to repeat even though another key has been struck.

For me, the effect is that the machine forced me to type as though it were a manual typewriter. It defeats the library of macros my hands have learned over years of typing. No other nonmanual keyboard I've used has these problems. Unfortunately, not every writer looking for a machine with the Attache's specifications will buy one on terms allowing its return, and even those who do may not discover until too late that the typos they're experiencing are happening because the keyboard wants to retrain them to type as though on a manual. It's a design flaw that potential buyers should know about before they buy. If, knowing of it, they try the machine and find they're unbothered, the machine is otherwise quite marvelous.

DICK LUTZ
Ocala, FL

You know, I thought you'd been sold a lemon when I got your letter; I simply didn't believe that Adeline had that flaw until I took her out of the case and fired her up.

You're right. You must release each key before pressing the next.

The funny part is that I'd probably have condemned the machine out of hand if I'd known that before I started to use it; but the fact is that I've done tens of thousands of words on my Attache, and I never noticed the "problem" until you called attention to it. For that matter, my colleague Norman Spinrad had no trouble with the Otrona, and neither does Larry Niven; and we're all touch-typists.

It's obviously software, and I expect a real Otrona wizard could rewrite the BIOS to change this feature; I wonder why Otrona doesn't offer some options? Alas, it has promised me the source code to the BIOS for months, but I still don't have it. Maybe I'll get it Real Soon Now, and I can look for a way to change the keyboard response.

Thanks.—Jerry

WILL I WAIT FOREVER?

Dear Jerry,

As a regular reader of your column, I have come to appreciate the point of view you advocate—on the side of the user of computer hardware and software. I fully agree with your stand on software protection, on the quality (or lack thereof) of most microcomputer documentation, and on the general chaos in the industry. But I do have a complaint.

Primarily on your recommendation, I sent a check to Workman Associates asking for a copy of WRITE for my Otrona. I've been using WordStar for some time but wanted something a little more free-form when writing something longer than a memo. WRITE seemed just the thing. I sent the order in early December 1983 and have yet to receive a voluntary response.

In the middle of January I called Workman to inquire about my order. A pleasant woman assured me that it had the order. She said that Tony Pietsch was finishing up the latest bugs, the documentation was being updated, and shipments for the Otrona would resume in 10 days.

That sounded reasonable. I looked forward to having WRITE with me when I took my Otrona on a three-week trip to Dallas. When it didn't arrive, I decided that I would look forward to spending some time with it when I returned. Now I'm just hoping I get the package before you get around to reading this letter.

This reminds me of your cases about the extremely long delays in shipments of JRT Pascal. True enough, Workman has not yet cashed my check; JRT cashed it immediately. But I ordered Vedit at the same time that I ordered WRITE. I received Vedit in less than a week. Incidentally, I am delighted with it, both the CP/M version and the MS-DOS version, both of which run on the Otrona.

I wonder if perhaps this is not another case of promoting a product before its time. I assume the people at Workman are your friends (why else would they write an editor just for you?). And I am sure they're very good at what they do. I'm in the software industry myself, and I know the pressure to get the product out before it's ready. You might, however, consider applying your own published standards to products in which you have a specific interest.

By the way, I'm writing this letter using the VM/CMS XEDIT editor, formatted using Waterloo Script. I was going to use my Otrona with a different editor, but . . .

TED BREWSTER
New Market, MD

What should I say? At the time I wrote the review, I had a version of WRITE on my Otrona. It worked fine, but there was indeed a later version in the works, and Barry didn't want to ship the old one when the new one was coming Real Soon.

Then when it was finished, it took Noor Singh some time to do the Otrona installation; Workman has WRITE going on about 100 different machines now, but alas, the only Otrona available was mine, and I had it with me on a trip.

WRITE 1.78 is done now and works fine; I use that version on all my machines. It has a wonderful update: even if you reset the machine, you can recover your text.

Indeed, the Workman family are friends, and my son works there as well, so I am not unbiased; but I do think they live up to fairly high standards. Workman's policy is not to cash checks until he can ship the product; that way, anyone can cancel an order without having tied up any money. He isn't making venture capitalists out of his customers. Alas, this time it took considerably longer than anyone expected.

I checked: your copy has been shipped. I hope you'll like it. I certainly do.

Glad you liked Vedit, too. I've never tried the MS-DOS version on the Otrona. Thanks for letting me know it works.—Jerry

COMPUPRO DOINGS

Dear Jerry,

You should razz Bill Godbout about CompuPro's new easy-as-pie manuals.

As Jan Wilson, our local computer genius, puts it, "This stuff defines a new standard for the term 'computer unfriendly.'"

You'll be sick when you add the hard disk. The 8-inch Fujitsu we are running (Pragmatic) has a transfer rate of roughly a million bytes/sec and is so fast we might as well not even have bought our three M-Drive/H boards.

Is there a CompuPro users group?

WILLIAM F. BURKE
Baton Rouge, LA

Let me repeat Pournelle's First Law: If You Don't Know What You're Doing, Deal With Someone Who Does. CompuPro equipment bought through a Systems Center will always be thoroughly integrated and do everything you expect. In your case, there being no nearby Systems Center, you may need a local wizard; fortunately, you seem to have found one.

I do razz Bill Godbout about manuals all the time. Think of the improvement: before I started on him, the folks at CompuPro used to put out a single sheet with each board, and their idea of support was to read the spec sheet over the phone! Fortunately, that has all ceased. I do agree the systems integration manuals for the boat anchor (S-100 box) could be improved.

I agree about the hard disk: I seldom use my M-Drive/H any more, except for big jobs like posting my books from journals. Last time, it took over an hour with the hard disk versus 10 minutes with the M-Drive/H, so there's still some reason to keep the memory-drive boards.

The address of the CompuPro users group is CPRO Users Group, POB 1474, Woodbridge, VA 22193.—Jerry ■


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Trends in Telecommunications

On-line search software and faster modems for PCs

BY JOHN MARKOFF

Now that the personal computer (PC) has won the battle for office desktop space, software developers are turning their attention toward programs that combine the storage capacity of mainframe computers with the local processing power of PCs. Although mainframes offer PC users access to huge on-line databases of specialized information, how to get to the information and bring it to the PC in a usable form is another question entirely.

In recent months, a new class of PC software has emerged that facilitates the redistribution of tasks between mainframes and PCs. It is called "on-line search" or "database-access" software, and these programs give us a glimpse of how radically PCs will alter the traditional mainframe database-access model based on one central processor and hundreds of remote dumb terminals.

In contrast, on-line search software uses the processing power of the PC to mediate between the researcher and the mainframe database and can offer potentially both a simpler user interface for novices and a more powerful searching tool for experts.

During the past decade there has been an explosion of new sources of electronic information. Several mainframe electronic-information providers such as The Source, CompuServe, and Newsnet have designed their systems specifically for novice users, but most on-line database services require special training to be used effectively. These include databases such as Dialog Information Retrieval Service, Nexis and Lexis, and Data Resources Incorporated.

The high cost of on-line information is also a deterrent to new users. Some databases on Dialog cost more than $100 an hour. This has meant that users generally must undergo extensive training to learn how to develop search strategies to minimize connect time.

REDUCING COSTS

PC-based on-line search software will be beneficial to database users because it will simplify complex user interfaces now found on many mainframe databases and it will permit extensive off-line preprocessing of searches, thereby reducing the cost of information retrieval.

On-line search software introduced to date can be placed in two distinct categories. The first category is composed of programs that are "loosely coupled" to a specific mainframe database. These programs are extensions of intelligent communications software programs and generally permit automatic log-on, query, and downloading from a host mainframe computer.

The second category includes software that has been "tightly coupled" to one or more particular databases. By tailoring programs for interaction with a host computer, software designers are able to create user interfaces that require little knowledge on the part of the user of either micro-to-mainframe communications or the formal database query process.

The emergence of new communication network standards and standards in the on-line information industry will tighten this coupling to the point where the relationship between the mainframe database system and PC software will approximate the current relationship between operating systems and application programs.

Dialog, a subsidiary of the Lockheed Corporation, is the largest collection of public on-line databases. It has more than 75 million records of information including articles from over 60,000 journals. These records are contained in more than 200 separate databases ranging form biographic databases such as *American Men & Women of Science* to statistical databases such as *U.S. Exports.*

Most Dialog reference records are currently available as abstracts that require you to go to a library to obtain the entire article or source (articles can be ordered on line for an extra fee). However, there is a trend toward making the full text of documents available on line. One Dialog database provider, Information Access Corporation, recently introduced two such databases, called *Magazine ASAP* and *Trade & Industry ASAP*, that will cover

(continued)

John Markoff is a BYTE senior technical editor. He can be contacted at 1000 Elwell Court, Palo Alto, CA 94303.

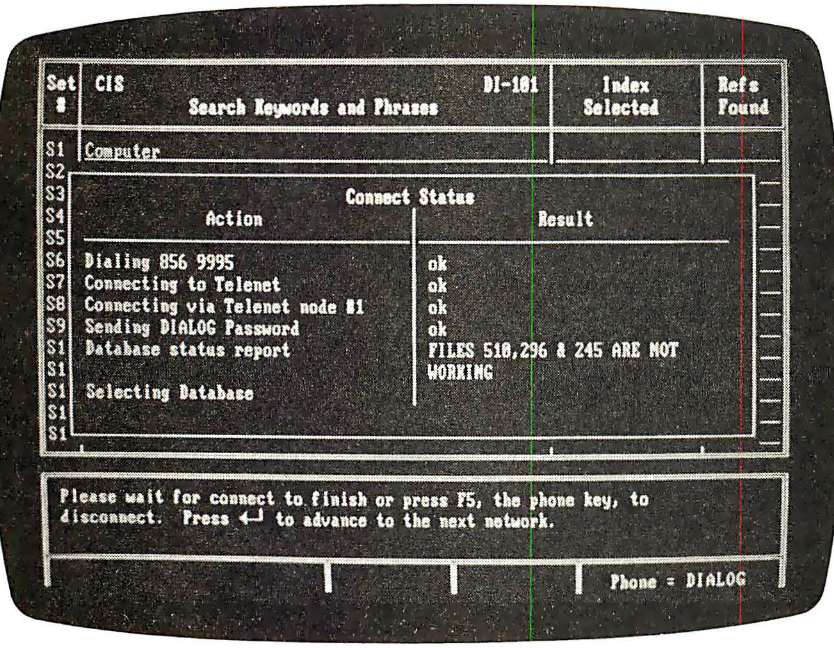


Photo 1: *After installing the proper Dialog password and Telenet, Tymnet, or Uninet network phone numbers, In-Search will automatically connect to Dialog and execute a search in a selected database. Dialing and automatic log-on are done by pressing the F5 function key on the IBM PC. During the dialing and log-on sequence, In-Search opens a window on the display to show current connect status information. If one network dial-up is busy, In-Search will automatically try other network numbers if they have been installed.*

If a search has been prepared in the query editor, In-Search will automatically execute the search after it is connected to Dialog.

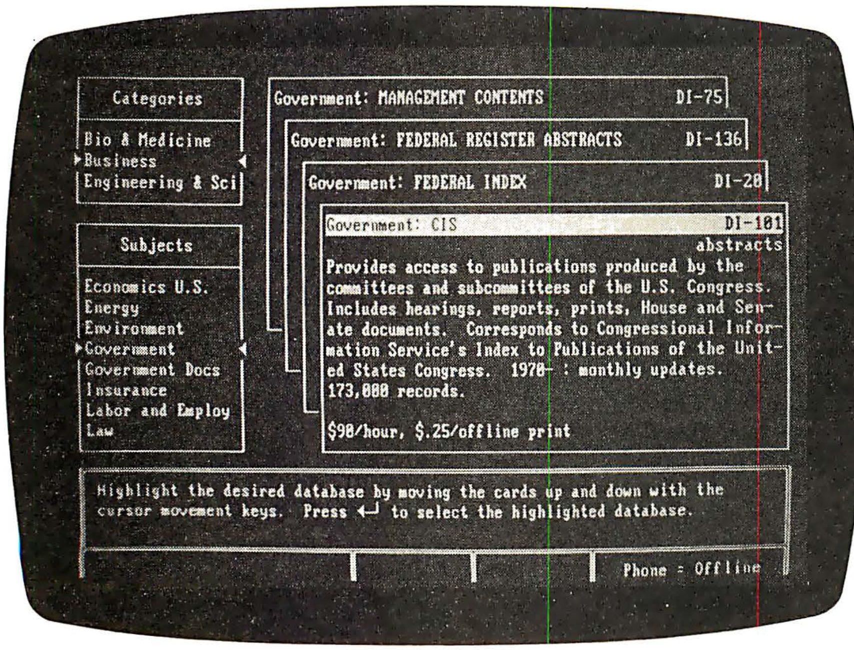


Photo 2: *This is the initial In-Search display shown when you first enter the program. The category and subject windows on the left side of the screen aid in focusing a search. The file-card windows in the center of the screen give a brief overview of each of the more than 200 databases available in Dialog. When the designed database is highlighted, you can search it by entering the query editor and preparing a search request while either on line or off line. More detailed on-line information is available on any database. The window at the bottom of the screen serves as a context-sensitive command menu.*

120 different popular magazines and publications ranging from *Scientific American* to *Playboy*.

IN-SEARCH

In-Search is an example of an on-line search program that has been tightly coupled with the Dialog databases.

In-Search, initially designed to be used on the IBM PC or PC XT, was introduced recently by the Menlo Corporation of Santa Clara, California. This program costs $399. It differs from other database-communication programs both in its scope (the program and its assorted reference files occupy more than one megabyte of disk space) and in the sophistication of its user interface, which offers a window-based display environment and "unhooks" the control of the database query process from the Dialog mainframe computer. "Unhooking" means that you're able to prepare your query in a screen-oriented editor while either on or off line. The process takes place with little interaction with the Dialog mainframe computer.

If the query has been prepared off line, you can log on to *Dialog* and have the query sent automatically. When Dialog responds with abstracts, they appear specially formatted in an overlapping window display.

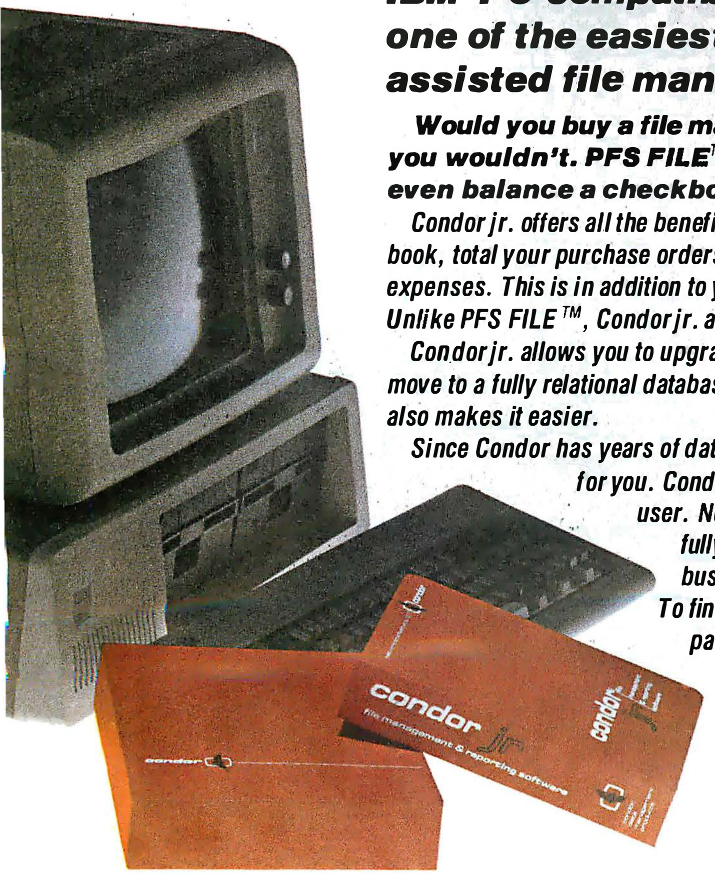
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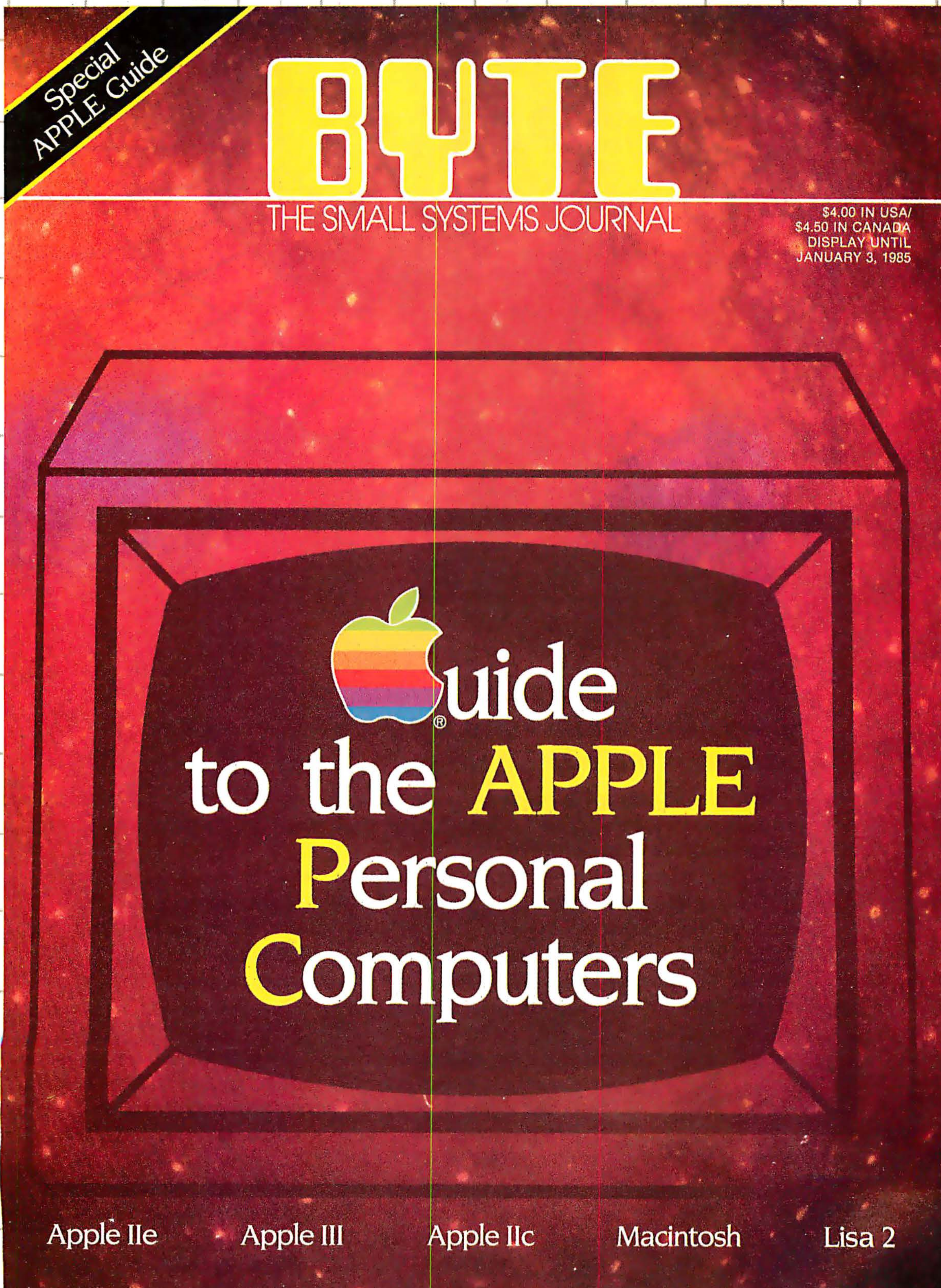
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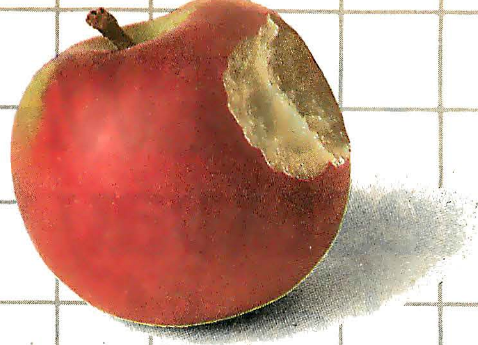
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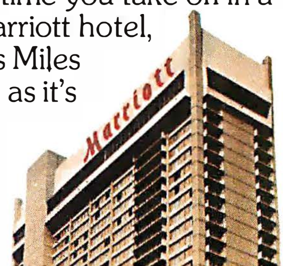
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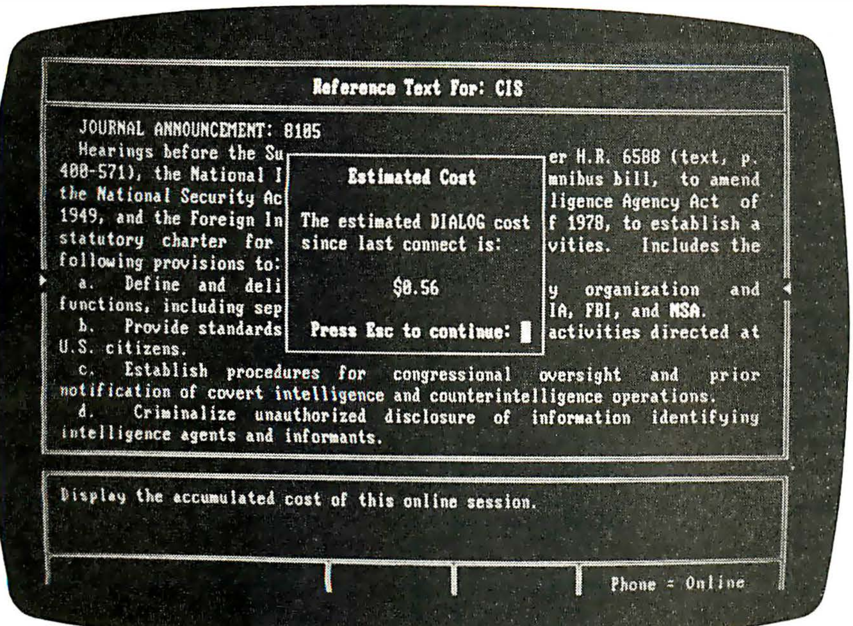


Photo 3: *At any time during a search session, In-Search will extract information on the cost of the current search from Dialog. When you first log on to Dialog, you are automatically placed in the Educational Resources Information Center (ERIC) database. This database is priced at $25 an hour, less expensive than many other databases in Dialog, which occasionally are priced in excess of $100 an hour. Dialog automatically places you in a more expensive database only during the time actually spent searching and downloading information from that database. Currently, In-Search does not supply you with information on the total cost at the conclusion of each session.*

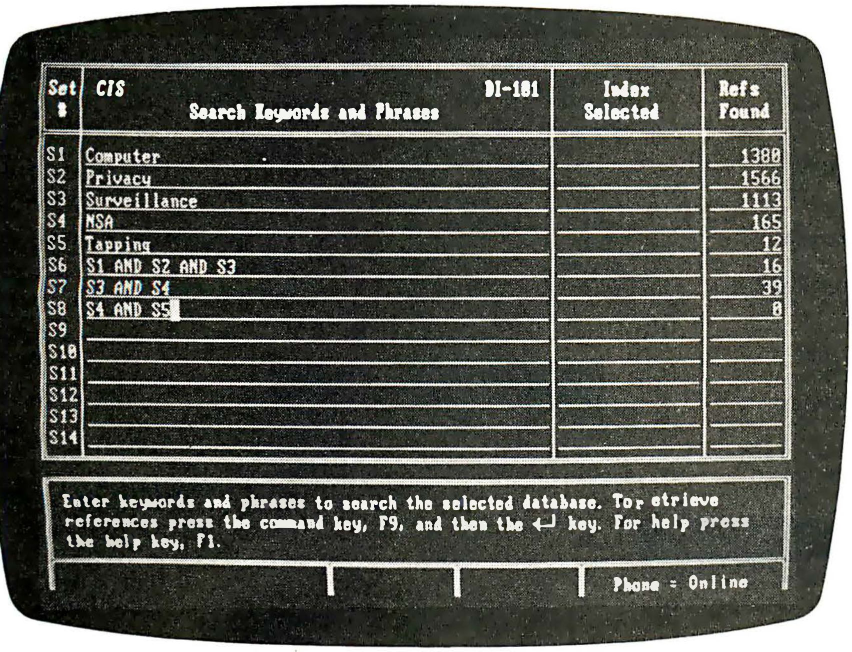


Photo 4: *An example of a Dialog database search. The current database is the Congressional Information Service (CIS) that provides access to abstracts of publications produced by the committees and subcommittees of the U.S. Congress. This display screen is the query editor. You can enter keywords or phrases on each line. Lines S6 through S8 are examples of how In-Search will direct a particular search to locate references that contain several words or phrases. After determining how many references exist, In-Search will retrieve them from Dialog and format them for display or output to a printer. When they are displayed on the screen, an overlapping window appears over the query editor for text display.*

dependent on the control of a remote mainframe computer. If you wish to interrupt the flow of information from the Dialog mainframe, you can do so simply by paging backward or forward through the information in much the same way that you can scroll through a text document in word-processing software. Because information from Dialog can be captured in a buffer (In-Search tailors the size of the buffer to the available memory level of an individual computer) on your PC, it's possible to selectively mark records for later printing. You also can store retrievals to disk as ASCII (American National Standard Code for Information Interchange) text that can be edited by a word processor or called up for viewing by In-Search.

In designing the In-Search user interface, Menlo Corporation has attempted to take concepts from other popular types of PC software. For example, when working in the query editor, you can edit and change lines of text exactly as though you were working with a document text editor. In-Search has even supplied users with the option of the familiar WordStar command-key sequences for cursor control and word and character deletions (the cursor-control keypad is functional as well). The basic In-Search display also contains a menu of command options that are ar-

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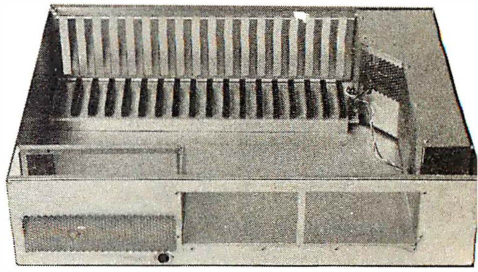
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ranged similarly to those provided by electronic spreadsheet programs. By pressing a function key, you can enter a command mode and select a command that will cause In-Search either to send a particular command to the Dialog system or to retrieve information from its own local database.

Although it is possible to first prepare a particular search strategy off line and then retrieve references quickly to minimize connect-time charges, In-Search is based on a different, more interactive philosophy of on-line database use.

Menlo's president, Lloyd Kreuzer, argues that In-Search is designed to function in a highly interactive manner. This sets it apart from other PC front-end software packages that assume you know what you want before going on line.

In contrast, Kreuzer believes that the most effective way to use a database like Dialog is to be able to alter a search strategy depending on the nature of the data revealed on a search. "Interactive searching is less precise and therefore more likely to turn up things," he says. "The keyboard is never dead and [in fact] it is uncoupled from the Dialog process."

When using In-Search on a fixed disk, the program provides local on-line detailed information on each individual database. This information, traditionally provided as printed textual documentation by Dialog (on forms called "blue sheets"), allows you to obtain information on the scope of an individual database as well as information on specific database indexes that aid in refining searches.

In-Search also supplies you with local context-sensitive on-line help both for using Dialog and In-Search. If you have an IBM PC without a fixed disk, you must insert one of four separate floppy disks that represent major database categories: arts, education, and social sciences; biology and medicine; business, government, and news; and engineering, mathematics, and physical science. On a fixed-disk PC, these files are directly accessible by the program and in the future it may be possible for the Menlo Corporation to use Dialog to download updates both to the on-line reference sheets and to the In-Search program itself.

The search process begins with selection of a database to search in. The first In-Search display shows three windows. Two small windows on the left side of the screen allow you to select one of the four major categories and to select further specific subject areas within each category. After you select category and subject you can select a specific database. At this point you are placed in the query editor (In-Search calls this the Search Keywords and Phrases screen) to formalize a search.

After In-Search sends the query to Dialog, the references yielded by each

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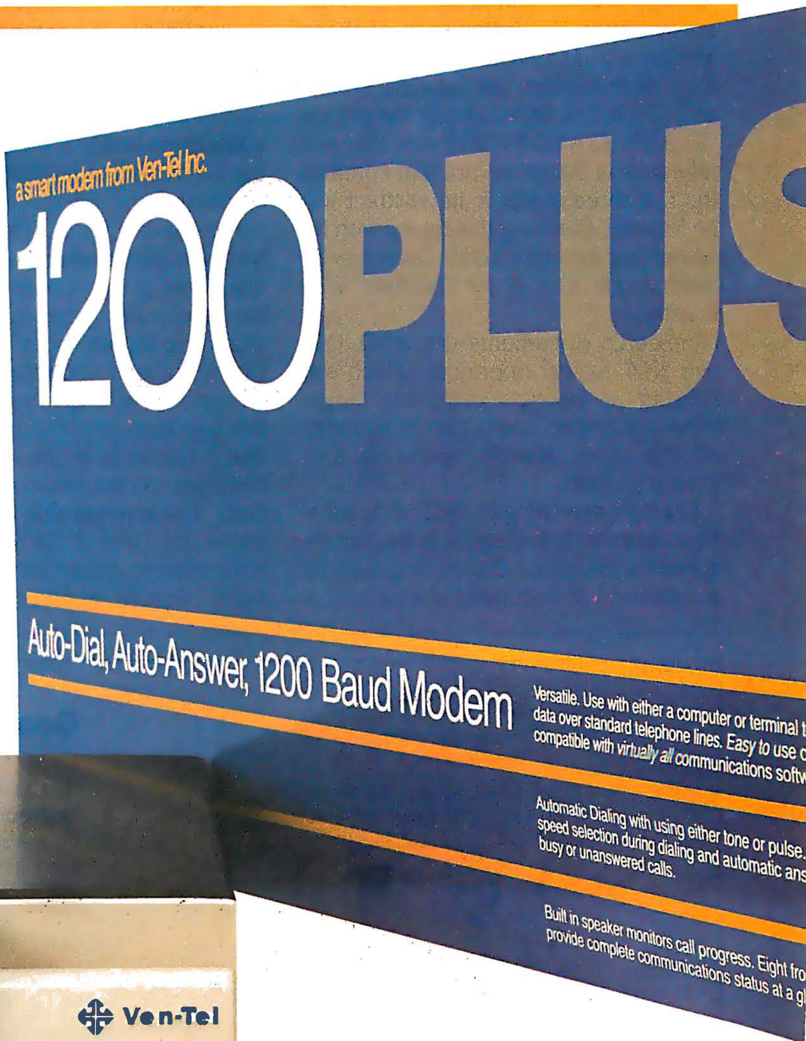
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Can be used with CROSSTALK-XVI or Smartcom II software	Yes	Yes
Regulated DC power pack for cool, reliable operation	Yes	**No**
Eight indicator lights to display modem status	Yes	Yes
Speaker to monitor call progress	Yes	Yes
Attractive, compact aluminum case	Yes	Yes
Two built-in phone connectors	Yes	**No**
Compatible with The Source and Dow Jones News Retrieval	Yes	Yes
Unattended remote test capability	Yes	**No**
Phone cable included	Yes	Yes
Availability	Now	
Price	**$499**	**$699**

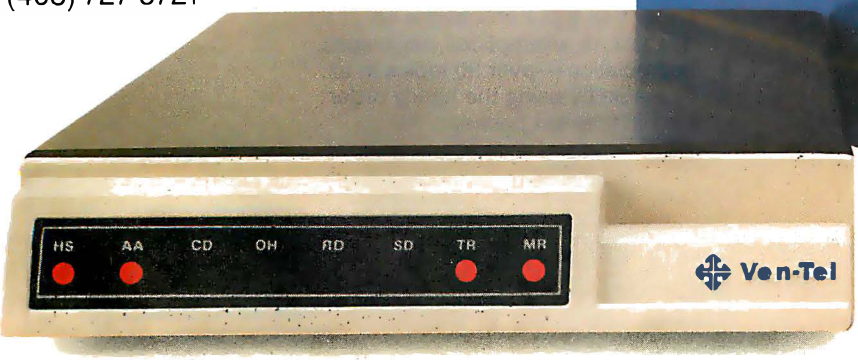
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search are displayed in a separate window referred to as a reference text display. Any search words that you entered in the query editor appear as highlighted text as they are scrolled on the reference text screen.

At the same time, information on modem status is given in a small window in the lower-right corner of the display. When Dialog is sending records, the window indicates Phone-Working. The status changes to Phone-Online after the records have been retrieved or when you interrupt the retrieval process.

For a simple search to answer the question "Are there any books currently available that describe bicycle tours of the California wine-growing region?" You would first select the Books in Print database and then enter the words "bicycle," "wine," and "California" in the query editor. You enter each of these words on a separate line. The first three lines of the editor are labeled S1, S2, and S3. On line S4, you enter the phrase "S1 AND S2 AND S3" to insure that any reference in Books in Print that contains the first three words in its abstract will be located. (Running this query with In-Search located one book: *Grape Expeditions: Bicycle Tours of the California Wine Country.*)

In-Search documents the AND, OR, and NOT logical operators, which are subsets of Dialog's complete range. However, expert users can implement all the other search operators that Dialog permits.

Effective searching of the Dialog database, even with In-Search, is frequently complicated. Since Dialog is generally a collection of document abstracts, it is heavily indexed, and it is important to understand the structure of the indexes to conduct a complete search.

A Dialog database is broken into records that are composed of fields. A typical record might include fields such as title, author, journal, abstract, descriptors, and identifiers. (Descriptors and identifiers are standard and nonstandard terms used by the database publisher to identify the subject matter of a record.) Each field is indexed either as a word index or as a phrase index.

In-Search gives you on-line access to specific indexes for each database. You can select an index for any term or phrase entered on the query editor screen. You also can send the Dialog database an "Expand" command that shows a listing of indexed words around the particular search word for a particular field in the database. This often will aid in narrowing down the focus of a search. (It is possible to search only one Dialog database at a time, however, some preselection is possible by searching the subject index first with a special command.)

The importance of indexed searching was exemplified when I searched for my last name in The Computer Database. No references were found; however, when the author index was specified, Dialog located 106 references.

Possibly the most intriguing aspect of this new class of software is the change that it portends in the realm of microcomputer-to-mainframe communications. The analogy that casts the mainframe database in the role of an operating system, linked simultaneously to many remote application programs, brings many possibilities into view. In this model, interaction between microcomputers and mainframe computers would be similar to program calls to an operating system.

Menlo's Kreuzer has called upon online database providers to develop an open-architecture, machine-to-machine interface standard that would permit third-party software developers to create a new generation of applications programs.

"(What is needed is) a universal set of calls to create an open standard for the on-line community that will let us, or anyone, write applications programs," he says. "The information industry literally will explode once we have a machine interface to all the data."

Such an architecture would move in a philosophically different direction than the one currently being followed by some on-line information providers who have been setting up systems based on hierarchical "user-friendly" menus for novice users.

Instead, Kreuzer is aiming at fundamentally changing the division of labor between mainframes and PCs. While it is logical that the data searching and sorting algorithms will remain on the mainframe computer, the PC can be expected to handle the user interface, on-line help, and preprocessing of the search request more efficiently.

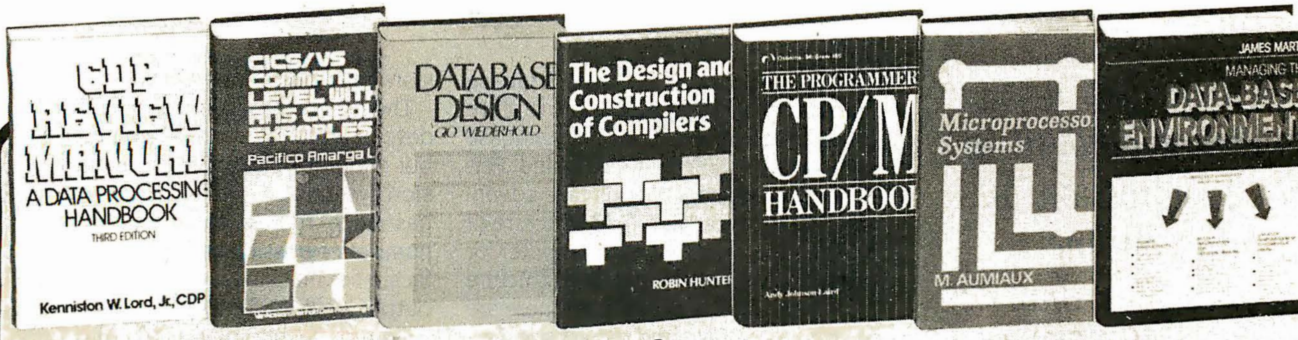
Further Benefits

Tighter coupling of the communications process between mainframe host and remote PC potentially can yield other dividends as well. Higher data-commu-

(continued)

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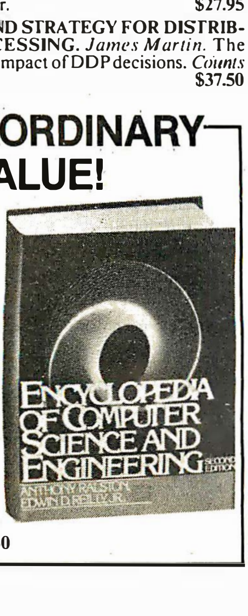
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In-Search uses a significant amount of data compression on the large on-line reference files that are stored on the PC to reduce their size by almost 40 percent.

nications speeds is one obvious possibility. In-Search already uses a significant amount of data compression on the large on-line reference files that are stored on the PC to reduce their size by almost 40 percent. There are a series of simple strategies for increasing the data-communications bandwidth as well. If the applications program can be coupled more tightly to the host computer, it is possible to employ a variety of data-compression strategies to go beyond the current 1200-bps (bit-per-second) limitation over phone lines.

Post-processing is another significant area. While In-Search currently formats only downloaded information and stores it to disk or outputs it to a printer, several other on-line search programs permit later manipulation of information as well. SciMate, from the Institute for Scientific Information (ISI) in Philadelphia, is an on-line search program that is priced at $880 and designed for IBM PC, Apple II, and CP/M computers. It provides for automatic log-on and query of four different database systems and includes a local database manager that makes it possible to store downloaded information. The database component of SciMate is called Personal Data Manager. It will take advantage of the record and field structure of information from a host computer or permit you to create your own structure for a local database. Although there are limitations on field and record size, Personal Data Manager permits you to link records to store longer textual documents. You also can move files to word-processing programs or merge locally created notes or documents into the database.

In a smaller fashion, Informatics General Corporation and VisiCorp have developed two complementary programs, Answer/DB and VisiAnswer, that permit the transfer of quantitative data from a corporate mainframe computer to an IBM PC where it can then be loaded into a VisiCalc spreadsheet program for local analysis.

Faster Modems for PCs

Today there are a series of barriers confronting high-speed PC data communications. Most of these barriers fall within the realm of the voice-grade telecommunication network and into existing modem technologies designed to send data over this network.

Yet, while digital technologies are promising dramatically higher communication speeds, a series of new modem designs is being introduced that will bring PC-to-PC data rates up to 9600 bps and, with additional data compression, may push speeds higher.

The new technology wasn't originally developed for personal computer users, but rather for digital-facsimile transmission systems. Now that the technology has been moved to PCs, it raises a number of possibilities, including using facsimile machines as remote input-output devices for PCs.

Gamma Technology, a Palo Alto, California, data-communications corporation, recently introduced the FAXT-96, a half-duplex 9600-bps synchronous modem board for the IBM PC and PC XT.

Priced initially at $1995 and designed to be used with a synchronous adapter card, the FAXT-96 plugs directly into a card slot in an IBM PC or PC compatible and permits 9600-bps communication over ordinary dial-up telephone lines. The modem includes auto-dial, auto-answer, and multiple-speed features. It connects directly to a phone line and to a synchronous adapter.

The use of dial-up 9600-bps communications is new. It has been made possible because of improvements in modem technology and improvements in the method of encoding digital data on bandwidth-limited voice-grade lines. Control of the FAXT-96 is handled in software from a "master control panel" screen on the IBM PC.

Previous high-speed synchronous modems have been stand-alone units that have been intended for either remote-terminal or micro-to-mainframe communication. The Gamma Technology modem differs in that, although it can be used as a high-speed micro-

(continued)

to-mainframe communications link, a software package also is being offered that permits error-checked PC-to-PC file transmission at 9600 bps.

The shift from asynchronous to synchronous transmission protocols at higher data rates frees the communication process from the start-stop bit overhead, a difference that automatically yields about a 20 percent increase in transmission efficiency.

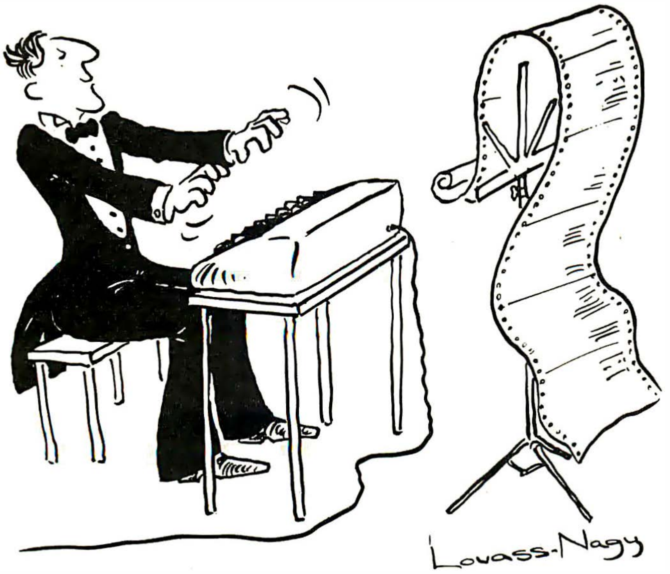
The significance of higher data communications rates has grown with the deregulation of the communications industry because communication costs are expected to rise. Gamma Technology is claiming that an eightfold increase in data rate (from 1200 bps to 9600 bps) will save several thousand dollars a year if 160K bytes of information are transmitted daily across the United States. Savings would be even greater if data were transmitted overseas.

The FAXT-96 can be programmed to meet several international modem standards set by the CCITT (International Consultant Committee for Telegraph and Telephone). The standards include CCITT V.29 at 9600, 7200, and 4800 bps and CCITT V.27 at 4800 and 2400 bps. Until now, U.S. modem signaling standards have been dominated by AT&T-developed standards. That's changing, both because of the global need for communications and because AT&T has less influence in an area of deregulation.

There are some limitations. Because sending data at 9600 bps is pressing to the limit what currently is possible with voice-grade lines, poor line quality can make it impossible to send data at that speed. To cope with line-quality problems, the Gamma Technology modem automatically tests line quality during an initial handshaking phase and then sets transmission speed at the highest data rate the line will support, ranging from 9600 bps down to 2400 bps. The line test is done by having one system send a known signal to the receiving system. The receiving system knows what it is supposed to get and can make adjustments to make the closest fit.

A recent study by Xerox of facsimile-system performance showed that the same modem technology that Gamma is using would support 9600-bps data transmission worldwide approximately 75 percent of the time over voice-grade lines. Over domestic long-distance lines the 7200-bps rate had to be selected only 27 percent of the time.

In addition to cutting communications costs, higher-speed data communications opens up new applications. Facsimile-to-PC connections would make the transmission of the textual information possible for bit-mapped display on the IBM PC. At 9600 bps the facsimile-transmission time for an 8½- by 11-inch piece of paper is 30 seconds. Another possibility is for the transmission of specialized database information that includes diagrams or other images. ■



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BY WILLIAM RAIKE

This is my first column as BYTE's Tokyo correspondent. In the coming months I'll be bringing you news about developments in personal computers in Japan, an idea of what kinds of hardware and software are on the market here (and, for you software entrepreneurs, what *isn't*), and periodic stories about what people use their computers for. When computer shows happen, you'll read about them; when there is interesting hardware progress to be reported on, you'll hear about that, too. And living here in Japan, 10,000 miles or so from Peterborough, offers a unique perspective on the computer explosion in the United States; you'll read my fearless observations and predictions about that as well. If you would like to contact me, I can be reached at BYTE, POB 372, Hancock, NH 03449.

SEIKO'S WRIST COMPUTER

For this month's new product preview, I discovered the wrist computer system from Seiko. I couldn't resist it; I went right out and bought one. Not really a "wristwatch computer," this item is actually a system of components. The watch itself, or more properly, the "wrist unit," besides being a normal-size digital watch with alarm and stopwatch features, contains storage space for 2000 characters organized into two pages, or "memos," of 1000 characters each. The watch also has a liquid-crystal display (LCD) with four lines of 10 characters each. Each character is 5 by 7 dots. Buttons (it has only four) at the bottom of the dark-brown bezel allow you to select either Memo A or Memo B and scroll upward or downward, in addition to using the conventional watch, alarm, and stopwatch functions. You can begin scrolling at either the beginning or end of a memo and proceed either one line at a time or, by holding a scrolling button down, four lines at a time.

The legibility of the display is quite good. The characters are typewriter-size (about 12 per inch), except the time-display digits, which are one-and-a-half characters high for better readability. It has no light; after all, the case has to hold five CMOS (complementary metal-oxide semiconductor) LSI (large-scale integration) chips and one bipolar IC (integrated circuit) in addition to the display and a battery. The display has no shadows and the viewing angle is sufficiently wide. Display contrast, remarkably, is adjustable via a separate keyboard unit.

Data entry is accomplished with the separate keyboard unit, which is about the size of a Hershey bar and weighs a little over 2 ounces. The left side contains a square indentation into which you press the watch either to store data in it or to use the watch as a display for the calculator function. It has a QWERTY-style keyboard with 50 keys, plus a Return key and space bar, 4 cursor keys, 4 mode-selection keys, and 2 Shift keys. In the units sold here in Japan, the second Shift key enables each character key to enter a *katakana* character (one of the two sets of Japanese phonetic characters—the other is *hiragana*) in addition to upper- and lowercase alphanumeric entry. One feature I found slightly annoying was that the normal mode is uppercase instead of lowercase, with no shift-lock function. Other than that, the watch and keyboard units work like a charm and are easy to learn and operate.

In order to store data in the watch, you snap the watch into the keyboard unit and press the Transmit button on the watch; then select a memo page by pressing either the Memo A or Memo B key on the keyboard. You enter data (or do editing) simply by positioning the cursor and typing the desired text. When you press the Transmit button again, the process ends. The watch becomes a display for the calculator function by pressing CAL instead of Memo A or Memo B and then using the numeric keys and arithmetic operation keys on

(continued)

William Raike, who holds a Ph.D. in applied mathematics from Northwestern University, has taught operations research and computer science in Austin, Texas, and Monterey, California. He holds a patent on a voice scrambler and was formerly an officer of Cryptext Corporation in the United States. In 1980, he went to Japan looking for 64K-bit RAMs. He has been there ever since as a technical translator and a software developer.

they keyboard; using the CAL function has no effect on the data stored in the watch.

You may wonder how data is transferred between the watch and the keyboard, particularly because they have absolutely no connectors. The answer: a combination of electromagnetic coupling and serial transmission at 2048 bits per second.

In addition to the wristwatch and keyboard units, other devices are available: a "controller," which is the size of a small desk calculator and contains a small printer, and an interface adapter for interfacing between the watch and a personal computer.

The controller, according to the instruction manual, is programmable in Microsoft BASIC (using the wristwatch as its display), in addition to duplicating the data entry and calculator functions of the small keyboard unit. ROM (read-only memory) packs for games are also available. Unfortunately, the controller that was demonstrated to me was not working properly, so it was impossible to correctly evaluate it.

One of the Japanese computer magazines has reported briefly on the interface adapter, but dealers will only say that it will be available "Any Day Now." [**Editor's Note:** *"Any Day Now" is the Japanese equivalent of Jerry Pournelle's "Real Soon Now."*]

Being the first on your block to own one of these is sure to elicit oohs and aahs from your friends; no doubt there are multifarious uses for the thing. The amazing thing to me is not the technology; it's that the combined price for the watch and keyboard unit is less than $100.

AKIHABARA

A whole city district in Tokyo, called Akihabara, is the center of the consumer-electronics explosion. In future columns, I'll report on the goings-on there in the personal computer field and on new products. Upcoming topics will include the latest on two 16-bit machines from Sharp and Fujitsu, and some features of the upcoming Japanese-language personal word processors now appearing on the market.

TECHNOLOGY FRONTIER

The personal computer market in the next few years will be deeply affected not only by the new generation of 32-bit microprocessors, whose development is being pioneered in the United States, but also by advances in memory technology, such as the 256K-bit RAM (random-access read/write memory) chips now available in sample quantities from Japanese suppliers. And prototypes of 1-megabit RAM chips exist. Over the longer term, Tokyo-area university research groups are already pressing for development of a 100-megabit RAM by the 1990s.

In the immediate future, and of direct relevance to large computer systems, are extremely high-speed memory packages. Hitachi has just announced a bipolar memory module that, although low-capacity, has an access time of 4.5 nanoseconds. Hitachi claims that the density of circuit integration in the new module is the highest in the world.

Six bipolar LSI chips are bonded to a multilayer silicon substrate in a total area of one square centimeter to provide 6K bits of memory. The 108-pin quad package has a hefty heat sink because power consumption is approximately 6 watts. But Hitachi says the basic technology can be used to develop modules for other IC families, including CMOS.

C ACROSS THE SEA

Computers have been a part of my life for more than 20 years now. While more computing power is on my desk now than used to be available in the whole room it took to hold the IBM 704 that first grabbed my interest, I still have a sense of wonder about these quiet beasts. And I still get enthusiastic about developing a new piece of software that helps me or another user, sophisticated or not, get some job done more easily, quickly, or conveniently. So this column will contain descriptions and listings of programs that do that, along with programming hints that may help you write better programs.

Besides being a columnist, I do technical translation and free-lance software development, and sometimes consulting. That means I get to use my computer as a word processor nearly every day for between 20 and 60 pages of text. With that kind of motivation, I have good reasons for developing programs that help me get more out of my word processor. I use WordStar; while it may not be everything the heart could desire, it does just about everything a word processor should do, and simple postprocessor programs can do a lot to make it (or any word processor) more useful.

One example is something as elementary as word counting. Translations (and other documents) are often paid for on a per-word basis. Believe it or not, many translation agencies in Tokyo employ people to count words, *manually*, in each document they handle. (But you lose a sense of amazement at such things in Tokyo, where every major department store hires "greeters" to cheerfully and respectfully meet everyone coming into the store with a bow and a smile.)

Word counting is simple, even though WordStar imposes certain additional tasks, like ignoring "dot commands" (lines that begin with a period, used for document formatting) and coping with bytes that have the high-order bit set and therefore don't look like the characters they're supposed to be. (On your system, if you use CP/M to TYPE a WordStar document file, you'll probably see all kinds of graphics characters where the last letter in a word should be; on mine, I get katakana characters.) Written in C, the program shown in listing 1 is a straightforward software tool that does the job and also provides a foundation for more ambitious programs for processing WordStar files.

If you haven't yet gotten up the energy (or courage, or whatever) to start using the C language, you really should. It's an easy language to learn if you have some experience with at least one other programming language (even BASIC, to which it is not very similar).

C has replaced assembly language for perhaps 90 percent of my programming work. Programs get written faster and debugged faster, and they're portable (mostly). Most important, they're readable and maintainable.

Lots of C compilers are available these days (see the August 1983 *BYTE*), but I have only good things to say about C/80 from The Software Toolworks. The compiler-plus-assembler package sells for less than $50; the optional Mathpak, which implements the **float** and **long** data types, is about $30 extra and nice to have. The compiler can also generate code suitable for a relocating assem-

Listing 1: A *program in C to count words in WordStar files.*

```
#define EOF -1
#define MAXLEN 4000
#include TPRINTF.C
main ()  /* Count words in input. */
         /* For use with WordStar. Ignores hi bits set. */
         /* Ignores lines beginning with periods. (Dot commands.) */
{        char *wptr;
         char line[MAXLEN];
         int wl, nw;
         nw = 0;
         while (getline(line, MAXLEN) != 0)
                  {
                  if (dotcmd(line)) continue;
                  for (wptr = line; (wl = getword(&wptr)) != -1;)
                           if (wl) nw++;
                  }
         printf("%d/n", nw);
}
dotcmd(ptr)    /* Returns 1 if char at ptr is '.', 0 otherwise. */
char *ptr;
{        return (*ptr == '.' ? 1 : 0 );
}
getword(ptradd) /* Searches for a word starting at *ptradd */
/* This function returns -1 if no word is found */
/* (e.g., end of line), 0 if word is to be ignored, */
/* and a positive integer which is the length of */
/* the word otherwise */
char *ptradd[];
{        char *ptr; int len;
         ptr = *ptradd; /* *ptradd is a pointer (ptr); *ptr is a char */
         len = 0
         while (isspace(*ptr)) ptr++;
         *ptradd = ptr;
         if (*ptr == '/0' return -1;
         while (!isspace(*ptr) && *ptr != '/0') ptr++;
         len = ptr - *ptradd;
            if (len == 1)
                  {if (!isalpha(**ptradd) && !isdigit(**ptradd)) len = 0;
                  }
         *ptradd = ptr;
         return len;
}
getline(s,lim) /* Gets a string (including newline) from std. input. */
               /* 0 terminated. Returns the length of the string. */
               /* Zaps hi bits to 0 in all bytes */
char *s; int lim;
{        char *t;
         t = s;
         while (--lim > 0 && ((*t = getchar()) != '/n') && *t != EOF)
                  *t++ &= '/177';  /*zap hi bit*/
         if (*t == '/n') t++;
         *t = '/0';
         return t - s;
}
isspace(c)     /* Checks only for blanks and newlines, not tabs */
char c;
/* if (c == ' ') return 1; if (c == '/n') return 1; return 0; */
{
#asm
         LXI      H,2
         DAD      SP
         MOV      A,M
         LXI      H,1
         CPI      ' '
         RZ
         CPI      OAH
         RZ
         DCR      L
#endasm
}
#include stdlib.c
```

bler, if you wish, and comes closer than other more expensive C compilers to the full C standard. And the dealer is extremely helpful and responsive to inquiries, which means a lot when you're as far away as I am.

The word-counting program in listing 1 was compiled using The Software Toolworks C/80 compiler. In C, #include is a preprocessor directive that tells the compiler to insert a particular file from the disk into the source file at that point. This particular compiler requires the file TPRINTF.C or a similar file to be included when formatted output (e.g., a printf() statement) is used, such as for displaying the result (the word count) on the console. The #include STDLIB.C function at the end of the program includes the standard library routines, such as isalpha() and isdigit(), within the source file prior to compilation. (The library routines are preceded by #ifneed compiler directives, so that only the library routines that are actually required are compiled; this feature is useful when using the absolute assembler supplied with C/80 instead of a relocating assembler and linker.)

The structure of the main routine is as simple as it is short; successive text lines are read into a character array called line[], using the getline() function. If the line begins with a period (i.e., is a WordStar dot command), it is ignored and another line is read. The line is then scanned for individual words with the getword() function.

The getword() function does what its name implies; starting at the position in line[] that is pointed to by the pointer wptr, it scans subsequent characters in the line, advances wptr to point to the blank or newline character following the first word, and returns the length of the word as its value. (A "word" here is simply any contiguous sequence of characters terminated by a blank or newline character.) The function returns a value of -1 if no word is found, meaning that the end of theline has been encountered. A value of 0 is returned if the word is to be ignored; in this version, getword() ignores any word only one character long that is not a letter or a digit (i.e., any isolated punctuation).

The getline() function uses getchar() to read a line of characters from the

(continued)

Circle 35 on inquiry card.

Circle 27 on inquiry card.

Circle 145 on inquiry card.

Circle 243 on Inquiry card.

Circle 9 on inquiry card.

Circle 41 on inquiry card.

"standard input" into the array called line []. It differs from the usual C function with the same name (and probably ought to have been called something different, like getWSln) in that an AND operation is performed with each character and a mask (octal 177 or hexadecimal 7F) whose high-order bit is 0, in order to set the high bit in the character to 0. This task is accomplished in C with the statement *t++ &= '\177', which is a compact way to write both *t = *t & '\177' and t = t + 1. The local variable *t* is a pointer to the current character, so that **t* is the current character itself. Reading stops when either the end of the line (a newline character) or the end of file is encountered, and the line is terminated with a zero byte, as is normal in C. (In C, strings are simply arrays of characters that are explicitly terminated with a zero byte.) The function returns the length of the line, or a value of 0 if no characters were read, in which case the end of file is indicated.

The isspace() function, normally present in the standard C library, is coded here in assembly language both to illustrate how easy it is to include in-line assembly language in a C/80 program and for efficiency reasons.

Reflecting the origin of the C language, all programs written in C/80 accomplish I/O (input/output) redirection. This capability means that a C program such as this one, which reads its input from the "standard input" and outputs to the "standard output" (normally the console), can obtain its input from a file instead, simply by indicating the filename in the command line when the program is run. Thus, if the program shown in listing 1 is compiled and assembled to produce a program called WCOUNT.COM (to be run under CP/M), for example, it can be used to count words in a WordStar file called TEXT by typing WCOUNT < TEXT followed by a carriage return.

Coming Up

In future issues, look for a C program that allows you to implement "pipes," UNIX-style, and multiple-command lines under CP/M; dealing with the file directory yourself instead of using the operating system's DIR command; yet another sort program; more postprocessors for WordStar; and more. ■

Invariance

A computer card trick and a look at number narcissism

BY MICHAEL W. ECKER

Welcome to the world of mathematical recreation. The theme this month is invariance. In point of fact, there are several tricks in mathematics based on some kind of invariance. Some tricks, such as casting out nines, may be more familiar to you than others. Let's look at some of the lesser known ones.

A COMPUTER CARD TRICK

One of my personal favorites is one that you may have seen commercially available with special card decks. One player mentally picks a positive integer, say, from 0 to 63. The other player—the "guesser"—then shows six cards, each containing some of these 64 numbers, and asks whether the chosen number appears on each card. The first player indicates "yes" or "no." At the conclusion, the guesser is able to tell which of the 64 numbers was selected.

You might enjoy trying this game with your computer instead, letting it ask you the questions and give you the feedback. While I could have written the program (see listing 1) without the data statements, I would have given away all too quickly how this trick works. Figure 1 shows how the "cards" are presented. Because I work with a TRS-80 Model III and also a Sanyo MBC-555 (an IBM PC compatible), those of you with other compatible machines can probably run the programs I provide as is. If you have another machine, you will need to make some modifications to clear the screen, display a printout, and so on. In this case, CLS clears the screen, and the PRINT statements use commas afterward to keep the numbers in columns, the leftmost edges of which are 16 characters apart. You may replace the commas with tab statements to accommodate smaller or larger screens, or use semicolons and then print blanks.

Why does the trick work, mathematically speaking? If you analyze the program, you'll see that this program presents the cards, or screens, and adds a power of two if and only if the player replies "yes" (Y). Essentially, you are exploiting the following mathematical principle: Every positive integer can be represented in one and only one way as a sum of powers of two in which each power of two is used at most once. This concept may be considered the underpinning for base two, which in itself is interesting and certainly related to computers.

To illustrate, let's take the number 25. It can be represented as such a sum (with the restriction stated—each power of two used at most once) as 1 + 8 + 16, and in no other way, apart from the order of specifying 1, 8, and 16. Let's call this breakdown into a sum of powers of two the base-two decomposition. Now look at the cards again (see figure 1). Note that all the numbers on the first screen (a), which corresponds to card 1, require a 1 in their base-two decomposition. Note that 24, for instance, doesn't appear on the first screen precisely because its decomposition, 8 + 16, doesn't require or allow a 1 in it. For 25, you answer "yes," and the program adds 1 (2 to the power 0). It does not do this for 24.

This process repeats with the second card of choices (b). All the integers on it require a 2 in their representation. Because 25 does not require or allow a 2, the number 25 does not appear. You would answer "no" (N) for this screen if you chose 25. In a similar vein, all numbers in the third screen (c) contain a 4 in their base-two representation. Those in the fourth (d) contain 8, the ones in the fifth (e) have 16, and in the sixth (f), 32.

If you determine which screens contain 25, you will note that it is precisely the ones corresponding to 1, 8, and 16. The program adds them together to reform the original 25. Furthermore, this pattern is easy to read, as the appropriate powers of two are precisely the first numbers (in the upper left) of each card.

An alternate way of viewing the screens is to treat each "yes" response as a 1 and each "no" as a 0. Now look at the yes/no sequence as zeros and ones, but in reverse order. For 25, corresponding to 32, 16, 8, 4, 2, and 1, we have 011001. Because we generally omit leading zeros, this truncates to 11001, which is the base-two representation of 25.

(continued)

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(1a)
```
 1   3   5   7
 9  11  13  15
17  19  21  23
25  27  29  31
33  35  37  39
41  43  45  47
49  51  53  55
57  59  61  63
```
DOES YOUR NUMBER APPEAR ON SCREEN (Y or N)?

(1b)
```
 2   3   6   7
10  11  14  15
18  19  22  23
26  27  30  31
34  35  38  39
42  43  46  47
50  51  54  55
58  59  62  63
```
DOES YOUR NUMBER APPEAR ON SCREEN (Y or N)?

(1c)
```
 4   5   6   7
12  13  14  15
20  21  22  23
28  29  30  31
36  37  38  39
44  45  46  47
52  53  54  55
60  61  62  63
```
DOES YOUR NUMBER APPEAR ON SCREEN (Y or N)?

(1d)
```
 8   9  10  11
12  13  14  15
24  25  26  27
28  29  30  31
40  41  42  43
44  45  46  47
56  57  58  59
60  61  62  63
```
DOES YOUR NUMBER APPEAR ON SCREEN (Y or N)?

(1e)
```
16  17  18  19
20  21  22  23
24  25  26  27
28  29  30  31
48  49  50  51
52  53  54  55
56  57  58  59
60  61  62  63
```
DOES YOUR NUMBER APPEAR ON SCREEN (Y or N)?

(1f)
```
32  33  34  35
36  37  38  39
40  41  42  43
44  45  46  47
48  49  50  51
52  53  54  55
56  57  58  59
60  61  62  63
```
DOES YOUR NUMBER APPEAR ON SCREEN (Y or N)?

Figure 1: *(a through f) Sequence of screen displays generated using the program in listing 1.*

NUMBER NARCISSISM

Numerical curiosities can be fascinating. For instance, if you write the fraction $^{16}/_{64}$ and incorrectly cancel the sixes—most assuredly nonsensical—you get $^{1}/_{4}$, which just happens to be correct. Another example would be $^{19}/_{95}$ with the nines going out.

If you write the fraction $^{16}/_{64}$ and incorrectly cancel the sixes, you get $^{1}/_{4}$, which just happens to be correct.

I want to focus on a different question though. Suppose you take a positive integer—greater than 1 to avoid trivialities—and cube each digit. Take, for instance, the number 123. The cubes of the digits are 1, 8, and 27, respectively, for a sum of 36. Hmm . . . nothing exciting there. Now try it with 153. The digit cubes are 1, 125, and 27, for a sum of . . . 153, the original number! Now *that's* interesting. Mathematicians call such numbers narcissistic (of order 3, or power 3). Some books also call them Armstrong numbers. Two books that describe this phenomenon and are worth taking a look at are by Donald D. Spencer, *Sixty Challenging Problems with BASIC Solutions* (Hasbrouck Heights, NJ: Hayden Book Co., 1979) and *Computers in Number Theory* (Rockville, MD: Computer Science Press, 1982).

The program in listing 2 grinds out narcissistic numbers. Note the iterated multiplication used instead of exponentiation. In this way, you accommodate the vagaries of computer and calculator arithmetic and avoid the consequent errors that sometimes appear. Another solution might be to declare integer variables, which might also speed things up compared to using floating-point real numbers. Also note the use of string functions. You may have to adapt this program to suit your machine. For in-

Listing 1: BASIC *program for a computer card trick.*

```
1   CLEAR 1000
5   DIM A(6,32)
20  CLS
30  PRINT "            PLEASE THINK OF A WHOLE NUMBER FROM 0 to 63"
40  PRINT: FOR Z=1 TO 1000:NEXT Z:REM TIME STALLER
45  PRINT:PRINT:PRINT
50  PRINT "            PRESS <ENTER> WHEN YOU ARE READY TO CONTINUE"
60  PRINT:INPUT X$
70  CLS
80  FOR J=1 TO 6
90  FOR K=1 TO 32
100 READ A(J,K)
105 IF A(J,K)< 10 THEN PRINT " ";
110 PRINT A(J,K),
120 NEXT K
125 PRINT:PRINT:PRINT
130 INPUT "DOES YOUR NUMBER APPEAR ON SCREEN (Y or N)";N$
140 IF N$="Y" THEN S=S+2[(J-1):REM "[" IS EXPONENTIATION
150 IF N$< >"N" AND N$< >"Y" THEN 130
153 N$=" "
155 CLS
160 NEXT J
170 CLS
173 For Z=1 to 300:NEXT Z
175 PRINT "            OKAY, CONCENTRATE VERY HARD NOW. . ."
180 PRINT "            I AM READING YOUR MIND. . ."
183 FOR Z=1 TO 700:NEXT
185 PRINT:PRINT
186 FOR K=1 TO 2
188 PRINT"       ";STRING$(57,"=")
189 PRINT
190 NEXT K
193 FOR Z=1 TO 300:NEXT Z
194 PRINT"            AHA! YOU PICKED THE NUMBER";:PRINT S
196 FOR Z=1 TO 2500:NEXT
198 PRINT:PRINT
200 DATA 1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35
210 DATA 37,39,41,43,45,47,49,51,53,55,57,59,61,63
230 DATA 2,3,6,7,10,11,14,15,18,19,22,23,26,27,30,31,34,35
240 DATA 38,39,42,43,46,47,50,51,54,55,58,59,62,63
260 DATA 4,5,6,7,12,13,14,15,20,21,22,23,28,29,30,31,36,37
290 DATA 8,9,10,11,12,13,14,15,24,25,26,27,28,29,30,31,40,41
300 DATA 42,43,44,45,46,47,56,57,58,59,60,61,62,63
320 DATA 16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,48,49
330 DATA 50,51,52,53,54,55,56,57,58,59,60,61,62,63
350 DATA 32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49
360 DATA 50,51,52,53,54,55,56,57,58,59,60,61,62,63
```

stance, Texas Instruments computers use SEG$ in place of MID$. You can circumvent this translation if you are willing to settle for only looking up to a prespecified level, such as 1000, as shown in listing 3, or by judicious and clever use of the INT function. You also can investigate higher-order narcissism using powers greater than 3.

By the way, 153 has another interesting property. Start with any number that is a multiple of 3, say, the 123 we used earlier. Take the sum of the cubes of the digits; in this case, 1+8+27=36. Now iterate the procedure with 36 to get the sum of the cubes of its digits: 27+216=243. Repeating with 243 gives 99, which in turn gives 1458, then 702, then 351, then 153. Once you hit 153, because it is narcissistic of order 3, you keep getting 153. Hence, no matter with which multiple of 3 you initialize the algorithm, you keep getting pulled inexorably to 153. Try this with other multiples of 3 to see this "black-hole" effect using the program in listing 4.

To gain a glimmer of insight into why

(continued)

Listing 2: *Narcissistic-number-generating program using iterated multiplication.*

```
10  CLS
12  INPUT "HOW LOW DO YOU WISH TO TEST FROM":MIN
15  INPUT "HOW HIGH DO YOU WISH TO TEST UP TO":MAX
20  FOR N=MIN TO MAX
30  N$=STR$(N)
40  FOR L=2 TO LEN(N$):REM START AT 2 DUE TO UNDERSTOOD +
50  D(L)=VAL(MID$(N$,L,1))
60  C(L)=D(L)*D(L)*D(L)
70  SUM=SUM+C(L)
80  NEXT
90  IF SUM=N THEN PRINT "A NARCISSISTIC NUMBER IS":N
100  SUM=0
110  NEXT
```

Listing 3: *Simplified narcissistic-number-generating program for numbers to* 1000.

```
10  CLS
20  FOR H=0 TO 9
30  FOR T=0 TO 9
40  FOR U=0 TO 9
50  N=100*H+10*T+U
60  IF N=H*H*H+T*T*T+U*U*U THEN PRINT N; "IS NARCISSISTIC"
70  NEXT U
80  NEXT T
90  NEXT H
```

Listing 4: *Regardless of which multiple-of-three number you select, this algorithm always produces the number* 153*, as explained in the text.*

```
200  DIM A(15)
210  CLS
220  PRINT "IN THIS TRICK, I WILL ASK YOU TO GIVE ME A WHOLE NUMBER"
230  PRINT "WHICH IS A MULTIPLE OF 3. THE COMPUTER WILL THEN TAKE EACH"
240  PRINT "OF THE DIGITS AND CALCULATE THE CUBE OF EACH DIGIT."
250  PRINT:PRINT "THEN THE SUM OF THESE WILL BE DISPLAYED. THE PROCESS WILL"
260  PRINT "THEN BE REPEATED WITH THAT NUMBER, AS NEEDED, UNTIL"
270  PRINT "WE START GETTING THE SAME NUMBER. AMAZINGLY, THIS"
280  PRINT "MUST ALWAYS HAPPEN, AND ONE ALWAYS GETS THE SAME ANSWER!"
290  PRINT:INPUT "PRESS <ENTER> TO CONTINUE":XX
300  CLS:INPUT "GIVE ME A WHOLE NUMBER WHICH IS A MULTIPLE OF 3":N
310  PRINT
320  N$=STR$(N):L=LEN(N$)
330  IF ABS(N-INT(N))>.00001 THEN PRINT "A WHOLE NUMBER PLEASE!":FOR Z=1 TO
     700:NEXT:GOTO 300
340  IF ABS(N/3-INT(N/3))>.01 THEN PRINT "A MULTIPLE OF 3 PLEASE!":FOR Z=1 TO
     700:NEXT:GOTO 300
350  S=0
360  FOR I=1 TO L
370  A(I)=(VAL(MID$(N$,I,1))):A(I)=A(I)*A(I)*A(I)
380  S=S+A(I)
390  NEXT I
400  PRINT "THE SUM OF THE CUBES OF THE DIGITS OF LAST NUMBER IS":S
410  IF S=N THEN PRINT:PRINT "PROCESS IS COMPLETE."
415  IF S=N THEN PRINT "TO START AGAIN, HIT <ENTER>":INPUT X$:GOTO 300
420  IF S <>N THEN N=S:S=0:GOTO 320
```

we get this interesting property, note that a number of four digits or more will have the sum of the cubes of its digits being smaller than itself. Hence, iteration continually "pulls down" large numbers into a small range of numbers, namely those with at most four digits. Then, for numbers from 1 to 9999, consider the number obtained by taking the sum of the cubes of the digits, repeated

It just so happens that if you start with a multiple of 3, the first number you hit that begins a cycle is 153.

as needed. You eventually hit all or some of the numbers and so must get a cycle. For instance, starting with 55, you get 250, then 133, then 55 again, at which point you will keep getting the 55–250–133–55 . . . cycle. If you hit one of the narcissistic numbers, the cycle is of length one and keeps looping you back to that same narcissistic number the very next step. In either case, every number may be perceived as leading eventually to the beginning of exactly one such cycle. It just so happens that if you start with a multiple of 3, the first number you hit that is the beginning of some cycle is the number 153. Said in another way, all the multiples of 3 feed into the one cycle . . . 153–153 . . . I am not aware, offhand, of a more profound explanation for this phenomenon. (An uncanny coincidence was that this article's original manuscript was 153 lines long.)

We plan more installments of "Mathematical Recreations" on a rotating basis with other Kernel articles. Your comments, questions, suggestions, improvements, superior programs, and the like, as well as your indications of interest in this feature, will be most appreciated. Please write to BYTE or me, Dr. Michael W. Ecker, c/o BYTE, 70 Main St., Peterborough, NH 03458. Tell us what you think. ■

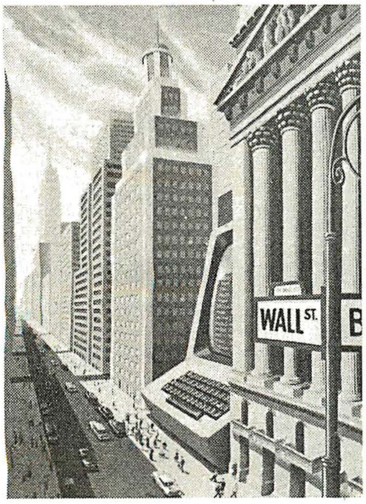
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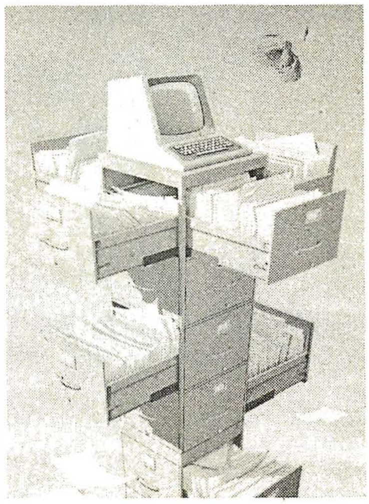
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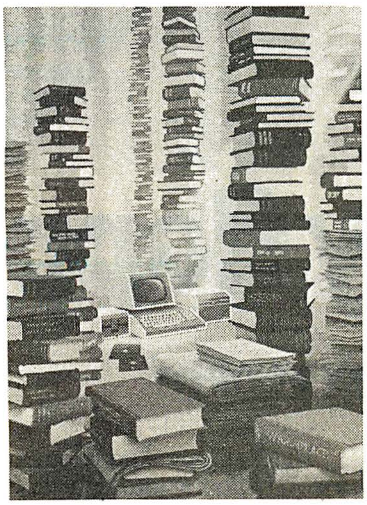
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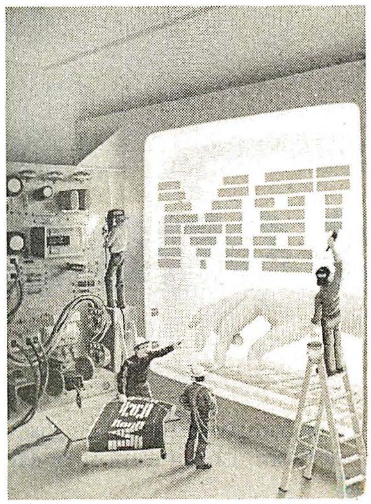
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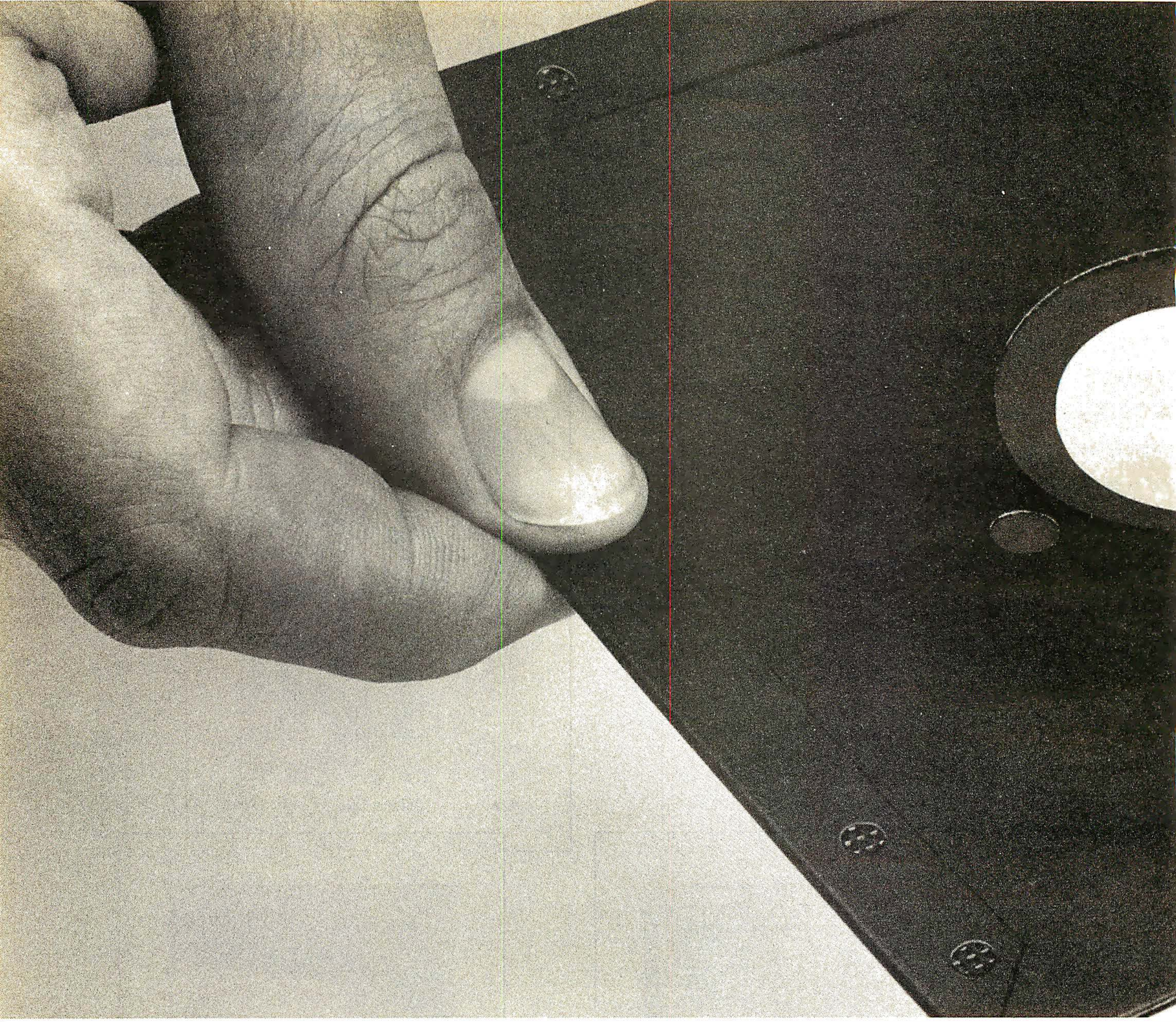
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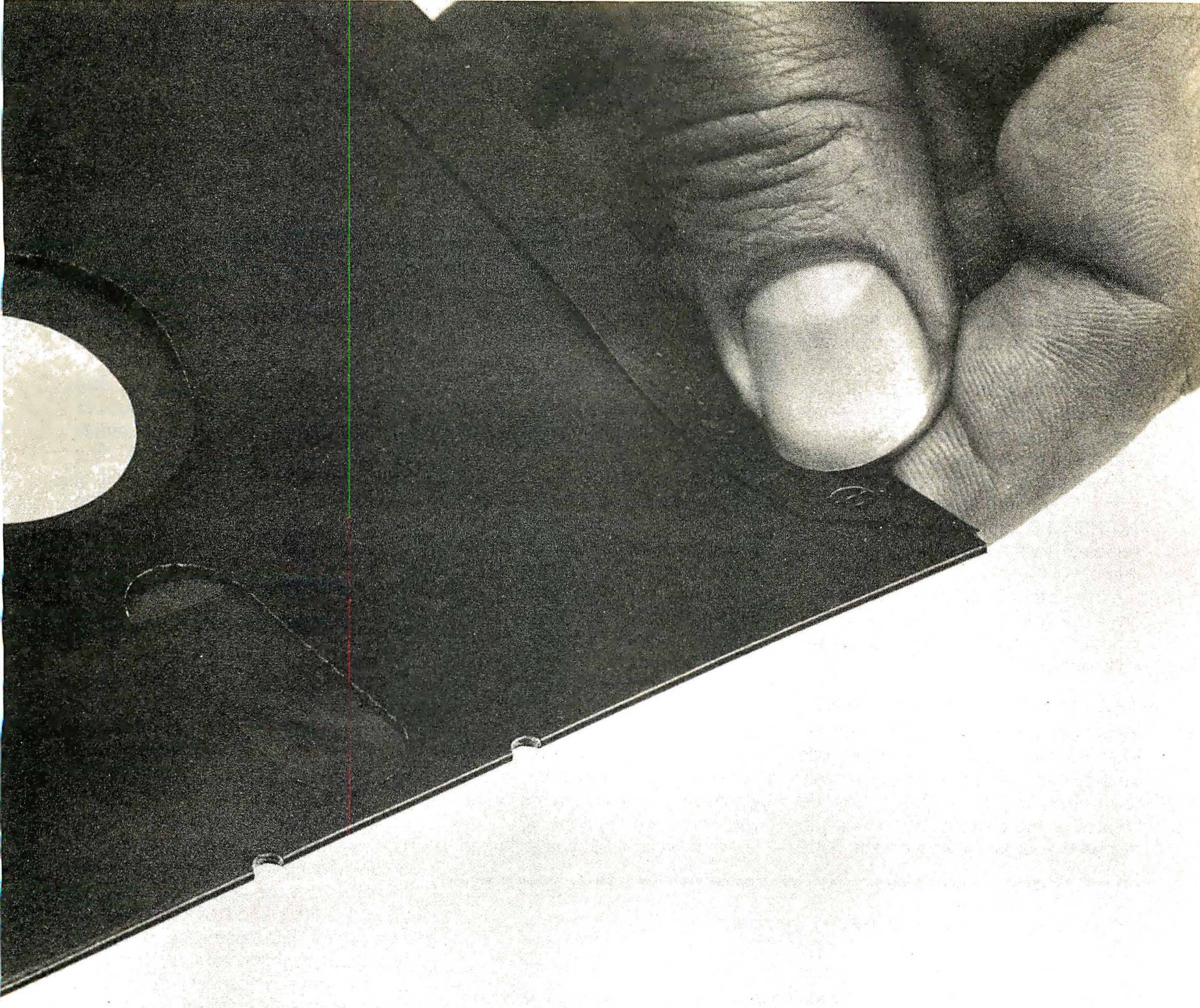
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No wide open spaces that can jam your drive. Lose your data. Or ruin your drive head.

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So why risk it?

Protect your drive. And your data. Ask for Memorex floppy discs, with Solid-Seam Bonding.

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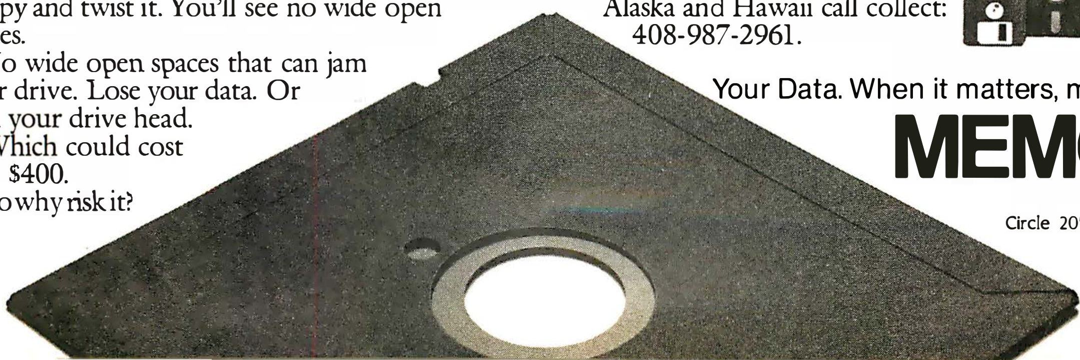
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(continued from page 123)

Are you ready for string arithmetic? Symphony includes some long-awaited string functions (see listing 1).

A valuable indexing function has been added enabling use of subscripted variables. The @INDEX(RANGE,COL,ROW) returns the value in RANGE at the COL and ROW specified. With this command, you can set up a matrix of values and easily access one particular value by specifying two variables (for example, age and salary). A RANGE-TRANSPOSE command is included that serves to switch rows and columns as it copies.

All the other features of Lotus 1-2-3 are alive and well in Symphony. All models developed with Lotus 1-2-3 are compatible with Symphony.

The Database Environment

Symphony provides you with a forms-oriented database with rows as records and columns as fields. A data-entry form, including error checks, can be created in the process of defining the database. You can create a custom database from scratch or use single command and default values. The latter and easier way is to specify the field headings down a column. One command and several keystrokes later you have a form ready for data entry. Symphony prepares a Setting sheet describing the database, which you can later edit. The database environment is fully integrated with the other four Symphony work environments.

A database form can be attached to a window using the FORM environment for easy data entry. For error checking, you can require that each entry be a number, label, date, or time of day. You might have each entry pass a test before Symphony stores it.

All the database features of Lotus 1-2-3 are present. Records can be sorted ascending or descending quickly using three keys. Numerical or string calculations can be performed using individual records or the entire database. You can even add new records to the database by receiving them from a remote computer over the telephone.

As with Lotus 1-2-3, you still need to specify criteria and output ranges for record selection. Statistical analyses can be performed on entire databases or on groups of records found in a search. The functions include average, count, max, min, standard deviation, sum, and variance of items in a range.

Graphs can be created using raw data in the database or using the results of statistical analysis. A variety of printouts can be made from databases including standard reports, invoices, mailing labels, and form letters—yes, you can get the database and word processor working together.

Listing 1: *String functions included in Symphony.*

@ASCII (STRING)	Returns ASCII (American National Standard Code for Information Interchange) code for the first character in STRING
@CHR(X)	Returns ASCII character represented by number *x*
@FIND(STR1,STR2,*x*)	Returns start of STR1 in STR2 starting at character *x*
@LEFT(STRING,*x*)	Returns *x* leftmost characters in STRING
@LENGTH(STRING)	Returns length of STRING
@LOWER(STRING)	Changes STRING to lowercase
@MID(STRING,*x*,*y*)	Creates string from *x* to *y* characters of STRING
@PROPER(STRING)	Changes STRING to initial caps
@REPEAT(STRING,*x*)	Adds STRING to itself *x* times
@REPLACE(STR1,OFFSET,*x*,STR2)	Deletes *x* characters from OFFSET in STR1; replaces with STR2
@RIGHT(STRING,*x*)	Returns *x* rightmost characters in STRING
@STRING(*x*,*y*)	Converts number *x* to string in fixed format with *y* decimal places
@TRIM(STRING)	Removes leading/trailing blanks from STRING
@UPPER(STRING)	Changes STRING to uppercase
@VALUE(NUM_STRING)	Converts NUM_STRING to numeric value
@DATEVALUE(DATESTRING)	Serial number of DATESTRING
@TIMEVALUE(TIMESTRING)	Serial number of TIMESTRING
@ISSTRING(TEST)	TRUE if TEST is a string

NOTES: 1) *x*,*y*, and OFFSET are single-cell numeric values
(cell address/range name of single cell, or a number)
2) STRING, STR1, STR2 are single-cell strings (cell address/range name of single cell, or string enclosed in double quotes)
3) NUM STRING is a single-cell numeric label (i.e., number being used as a label)

The Graphics Environment

If pictures are worth a thousand words, Symphony is not ignoring the fact. An impressive variety of printers and plotters are supported and a strong configuration program lets you make good use of them. However, as with Lotus 1-2-3, you still need to dump pictures to disk and exit to a separate utility to plot them.

All the graphics capability of Lotus 1-2-3 is present. Seven color graphs can be defined in Setting sheets, which, like the other environments, can be freely viewed, edited, and stored in a Setting catalog for later use. You can even browse through the catalog of defined graphs. Both spreadsheet and database numbers can be graphed.

The graphs can be attached to GRAPH environment windows where they become automatically updated during data editing at your option. You can then manipulate the size and position of the graph windows on the screen. They can be freely paged through and stored away at your discretion—there's great potential here for a slide show that uses macro files. Any active graph window can be expanded to full screen at any time using the Zoom command.

The Word-Processing Environment

In Symphony you can write, edit, format, and print a document without leaving the word-processing environment. You can create a document window, then blow it up to full-screen size by pressing the Zoom key. The top border of the screen will be marked by margin and tab indicators—and behold, you have a word processor.

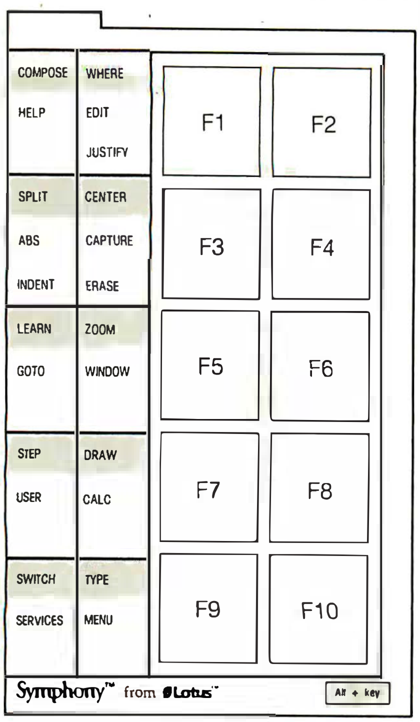


Figure 1: *The Symphony function-key template.*

Standard word-processing commands are available. Word-wrap is the default, but optional. Paragraphs only or the entire text can be justified right, left, or centered. You can move by character, word, line, paragraph, page, or markers inserted in the text. Ranges can be specified for Move, Erase, and Copy commands much like the spreadsheet. This is a very powerful feature.

Search and replace of word and phrases is supported with lowercase ignored and multiple replace and skip. Page breaks can be inserted in a document with a single keystroke. Individual lines or whole sections of the text can be independently formatted and the format definitions saved for later use.

The word processor appears adequate for generating reports. It is available to any window. Calculated spreadsheet cells can even be mixed in with text created with the word-processing environment.

The Communications Environment

The communications (COMM) environment lets you transfer files to and from another computer via hardwire connection or modem. You can even capture data during a communications session and send it to disk as an ASCII print file or send it to the worksheet to be edited in the document environment. Data can also be downloaded and inserted into spreadsheet models. The communications features available rival those of specialized communications software, especially considering the macro capability of Symphony to fully automate communications and integrate with other environments in the same program.

As with the other environments, Setting sheets can be created to configure Symphony for each computer system you want to call, and any setting can be loaded automatically with a model. A variety of configuration options are available.

For each Setting sheet you can specify the bits-per-second rate, parity, word length, and stop bits. The phone you use can be pulse or rotary dial with the called phone number specified for autodialing. Auto-log-in sequences can be defined in a log-in Setting sheet.

You can set the screen width for receiving data, set duplex, and even control character-set translation during a terminal session. To aid in talking to temperamental systems, the software gives you control over end-of-line characters to send, characters to handshake on, and delays after each line is transmitted. These features come in handy when trying to communicate with a variety of systems.

You can set the break-key duration and allow or disallow suspension of output for inbound and/or outbound transmissions. In the Install program, I noticed the default error-checking protocol used was XMODEM. This is a popular protocol. Error checking is imperative for the integrity of data transfer. After all, you want to be confident that all those numbers and formulas got through error-free. A missing 0 or character in a formula can be devastating.

The Programming Language

Strong features of Symphony are its macros, command language, and Learn facility. You can teach Symphony to perform tasks automatically. Macros (sometimes called script files or command files) consist of a column of label entries and/or string-valued formulas. The range of cells holding the macro can then be given an English name. Pressing one key and entering the English name executes all the commands in the macro.

The Learn feature of Symphony lets you switch ON a Learn key that remembers subsequent keystrokes and stores them automatically in a user-specified range within a column. Toggling the Learn feature OFF ends the macro, which can then be invoked to execute the same sequence of keystrokes. These macros can remember simple labels or headings to a complex sequence of events you would normally enter from the keyboard.

In addition to remembering and executing your keystrokes, a command language is available to extend the macro capability. You can declare argument types, create macro subroutines, pass arguments to subroutines, pause for operator entry, create menus, conditionally branch, iterate, and use GOTO. In short, you can program seriously with Symphony.

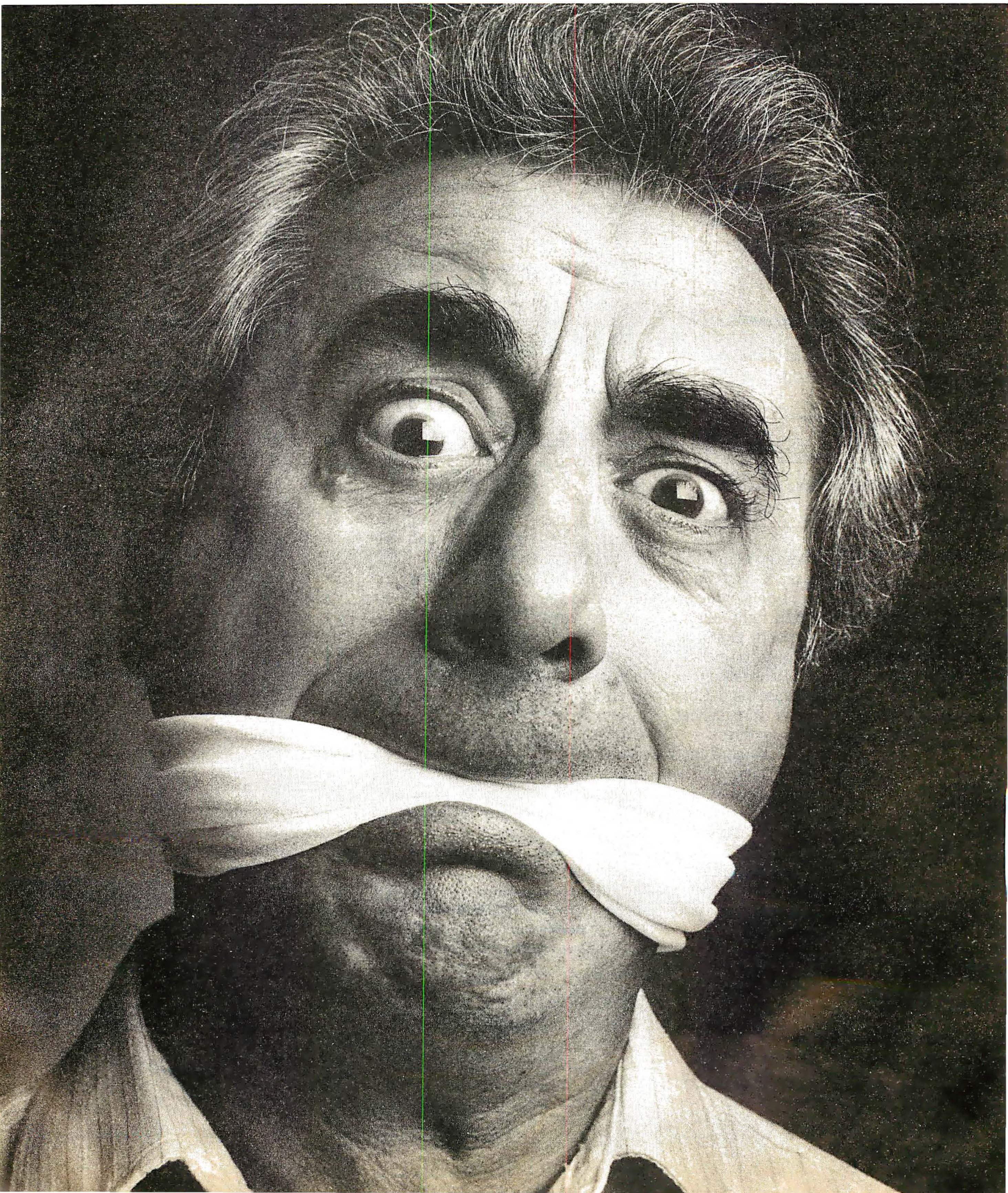
Summary and Conclusion

Lotus has taken the time to research and develop a good user interface to a very complex and powerful program. Although there is a bit of a learning curve using Symphony, the Help files respond precisely to the task you are performing and are designed better than ever. An on-line tutorial is also provided. The Symphony manuals include a glossary of terms.

Use of windows, the focused menu structure and Setting sheets all help to minimize confusion. Creative use of macro files and the command language can serve to further minimize user confusion. The ability to password-lock the worksheet ties everything up in a nice secure knot and prevents unpleasant overwrites and tampering with valuable formulas.

The potential Symphony provides for turnkey model building is profound—I must admit, now I'm less of a skeptic toward integrated software. I don't think much power was lost through integration. The program will vastly improve the quality of modeling on microcomputers. Now, excuse me while I don my tuxedo and slip away to spend a few weeks with Symphony. ■

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and data simultaneously, leaves a lot to be desired.

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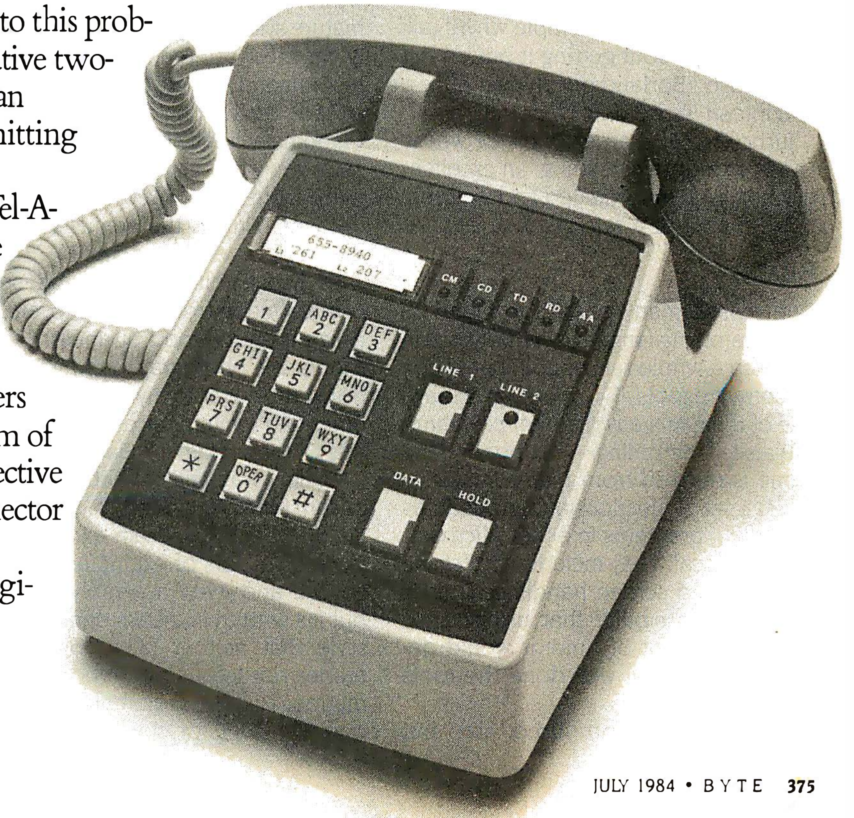
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(continued from page 137)
crowds. Borland's president, Phillippe Kahn, was there to demonstrate his product and to talk with anyone who'd listen. He's planning a whole line of products, all to be sold at under $70. Unlike most software publishers, Kahn tries to see how *much* he can include in his packages. For example, the PC version of Turbo Pascal comes with a nifty spreadsheet program—complete with source code. The source contains a number of screen-handling procedures I'd have been willing to pay separately for.

I'm pleased to say Turbo was selling like mad. In case anyone has any lingering doubts, let me repeat: Turbo Pascal is as good a Pascal compiler as can be found on the micro market regardless of price. The new Turbo 2.0 for the PC has overlays, allowing you to write big programs. The integrated editor is a feature found only in really expensive compiler systems. Turbo Pascal is, as I write this, the *only* Pascal compiler that will work with the IBM PCjr. Not even IBM Pascal will do that! Besides, Turbo is much better than the Pascal IBM sells.

Incidentally, Phillippe Kahn tells me that he tried to get IBM to market Turbo, but IBM wouldn't do it unless he raised the price to at least $200. For reasons he doesn't understand, he hasn't been able to find anyone at Apple who'll talk to him at all about getting it out on the Macintosh. (Borland doesn't yet have a Macintosh Turbo. Pity.)

Turbo Pascal is an example of where I see this industry heading: an excellent product, well documented and well supported, sold at a fair price.

Blaise

One reason many of us like Pascal as a programming language is that you can build up a whole raft of utilities—a box of software tools, if you like—and make use of them in many different programs.

Blaise Computing—I suppose the name is derived from Blaise Pascal?—offers a set of functions and procedures for writing programs in either Microsoft or IBM Pascal. They include both string handling and screen handling. There's a distinct possibility that using these could save a lot of time; it would depend on just how well done the tools are.

They don't support Turbo, alas, but source code comes with the tools, so it shouldn't be that hard to adapt. I haven't actually looked at what they offer, so I can't tell how much they go beyond the routines given in Peter Norton's book.

Friends and Books

One reason I like the West Coast Faire is that I meet a lot of old friends and make new ones. This year I met Doug Clapp, who has been, uh, kind enough to mention me in his columns. Clapp's book *Macintosh! Complete* was, I think, the first one on the Macintosh to be published; alas, it reads as if it were rushed into print, and most of what's in it is either elementary or full of goshwow! breathless awe of the machine. It wouldn't be a bad beginning book, except for the price, which is pretty steep for what's actually covered.

A better Macintosh book is Cary Lu's *The Apple Macintosh Book*, which goes into heavy technical detail but also covers a lot of elementary essentials. Like Clapp's book, it assumes there's going to be a lot of software for the Mac and that many of its problems will be solved. If you have to get your book out the same month that the computer appears, you'll always have this problem, of course. Eventually there will be books written by people who have used the mature system; until then, Lu's is certainly the best reference I've seen, and I recommend it to anyone who either has a Mac or is thinking of getting one. Alas, Clapp has a really bad case of Macworship; you won't get an objective assessment from his book.

Robert Tinney, the genius who does the BYTE covers, was at the BYTE booth with Susan, his wife. He was selling posters made from his old covers, and doing a pretty good business. He also took some photographs of me; he'll be doing the cover to my collection of columns and reminiscences that comes out this October from Jim Baen Associates.

While I was talking with Robert and Susan, I met Peter Norton, whose *Inside the IBM PC* is just plain excellent. The book gives lots of examples, in BASIC, Pascal, and even assembly language, but it's written in a clear and intelligent style that neither talks down to the reader nor leaves out important information. Highly recommended for anyone with a PC or close PC clone.

Infoworld, as usual, held a big blowout party; this year it was in City Hall. I ran into John Dvorak there and couldn't resist asking him to rate the party, but he wouldn't do it. Adam Osborne was also there. He'd just announced his new software development and publishing venture. He seemed happy enough. Alas, I couldn't stay long; the party featured a rock band and was held under the City Hall dome. Great acoustics if you want to be deafened . . .

Dimension

One of the most interesting hardware items was Micro Craft's Dimension 68000 "Professional Personal Computer." At CP/M East in Boston these folks had only one copy of the machine in their booth; now there were half a dozen, and they were selling them right there at the show; I noticed a couple of software companies buying, and Chris Rutkowski's Rising Star, which is overhauling the Epson QX-10 software, seemed decidedly interested.

The Dimension is supposed to run software written for nearly any 8-bit or 16-bit machine, including Apple, IBM PC, Kaypro, TRS-80, UNIX, and Osborne. The idea is that Dimension owners won't have to worry about software compatibility; one machine runs everything.

I've had no chance to examine the machine, so I merely report the company's claims. Micro Craft had one set up with transparent cover, and it looked well constructed, but that kind of inspection isn't worth much. It's certainly an intriguing concept.

The Big Mac

The most spectacular display at the Faire was Apple's giant-size model of a Macintosh. This big Mac is large enough to walk into! The screen is a projection image of a nearby normal size Macintosh, so that crowds of people can watch Macdemonstrations, and it certainly drew the crowd.

There were also several dozen Macintosh computers upstairs; those interested could make an appointment to go play with one for half an hour. Many people took Apple up on the offer, and they all seemed to come away with smiles. There's no doubting it: the Macintosh is *fun*. I haven't seen so much excitement since the very earliest days.

In spite of all the Macexcitement, there was essentially zero applications software for the Mac. No one had any hardware to hang on the Mac's I/O port (called a "virtual slot" in Macsales literature). There was a MacForth to be available Real Soon Now, and the FORTH people had a second disk drive—without a case—attached to the Mac. They'd apparently cobbled that up themselves; Apple wasn't supplying second drives. Or perhaps they were blessed.

Macintosh comes with Macwrite, a limited text editor, and Macpaint graphics-support packages. Apple expects outsiders to develop software for the machine. So far there isn't much. Except for Microsoft's Multiplan—which is copy protected on the Macintosh although the IBM PC version is not; presumably Macintosh users are less honest than IBM customers?—I saw only one other applications program for the Mac.

That was at the Workman and Associates booth: Bruce Tonkin, software author, shared Barry's booth. Bruce writes really complex programs in Microsoft BASIC (MBASIC). Actually, he writes in P-BASIC, which is a structured BASIC precompiler that compiles to, of all things, legal MBASIC. The P-BASIC compiler is written in Microsoft BASIC, so it wasn't very difficult for Bruce to get it onto the Mac.

He used it to write a highly complex database program called the Creator for the Macintosh. Guy Kawasaki, Apple's Macproject head, was quite impressed when he saw it running. It's a good program, not up to dBASE II, but good enough for a lot of serious business work, and it's fast (even in interpretive Microsoft BASIC).

That was all we found for the Mac. The machine has some limits, especially for serious business users. Lack of applications software is one major difficulty. A full discussion of this machine and what it means to the micro world will take more space than I have here and appears in this month's column.

More Networks

Bill Godbout's CompuPro company was proudly showing off the four-user Shirley; you'll recall CompuPro had a mock-up of it at the last Faire. Shirley puts four computers in a single box and internally networks them; each user has a central processor and memory banks.

The CompuPro folks announced that they'll be using Datapoint's Arcnet system to tie their multiuser machines together. This includes not only the Shirley machine (officially known as the "10") but also the new machine based on the iAPX20286 chip. The 286s are pretty expensive just now, but they are available to software developers.

CompuPro also had Concurrent CP/M 3.0 running on an 8/16 8085/8088 Dual Processor system much like mine. With

(continued)

four users and *eight tasks*, it worked, all right, but it was pretty slow. I'm much looking forward to getting Concurrent CP/M with windows running here, but I'll never put multiusers on a single microprocessor. One user, at least one central processor; that's the rule (mine, anyway).

Over the Rainbow

Digital Equipment Corporation had a large booth just next to Apple, but the people there seemed to have trouble generating any excitement.

DEC is a company that has learned fast. When the people at DEC first brought out their Rainbow PC, they seemed determined to isolate their users from the rest of the micro world. The Rainbow wouldn't even format its own disks! You had to buy them preformatted.

No more. Rainbow now reads lots of disk formats and runs all manner of outside software; DEC never tires of bragging about just how much. Like the Fujitsu, the DEC Rainbow has both 8-bit Z80 and 16-bit 8088 microprocessors and can run CP/M-80, CP/M-86, and MS-DOS software. It's a pretty machine, with a good display—and very nearly the same wretched keyboard as the IBM PC. Since the IBM designers have said in interviews that they just sort of "made up" the IBM PC keyboard, I wonder why DEC's salespeople insist theirs is some kind of European standard?

The Rainbow deserves more attention than it got; being next to the overcrowded Big Mac display must have been pretty grim for the DEC booth people.

Corvus

As I've reported in previous columns, we have a Corvus Concept computer. It implements Corvus's Omninet system, which lets us link up an Apple, IBM PC, Zenith Z-100, TI PC, and CompuPro S-100 bus system so that they can all share the Concept's large hard disk.

The only person I "know" at Corvus is a software engineer named David Ramsey, and I've never actually met him: we've corresponded and talked many times on the phone. When I spotted the Corvus booth at the Faire, I headed right for it. A rather pretty young lady with blue eyes was the only person visible.

"Is David Ramsey here?" I asked.

She didn't hesitate a second. "Oh, no. We don't let him come to the Faire. We keep him chained to his desk."

Alex was later told the same thing. This makes me more anxious than ever to meet him.

Corvus has made some changes in its system. For example, our Concept's hard-disk unit is very large, about 1¼ times as wide as an 8-inch disk drive and a little taller. This size is a hangover from the days when they shipped 8-inch hard-disk drives some years ago, since the drive inside is a 40-megabyte 5¼-inch drive. Corvus showed off a new hard-disk drive at the Faire. It's only a little larger than the 5¼-inch hard disk it contains.

The new model has the Omninet interface built in—ours has a separate unit, about 1½ times as high as a half-height 5¼-inch disk drive, to connect it to the Omninet. Believe me, the amount of space taken by these drives is large, so I was happy to see these improvements. Mr. Ramsey swears he's coming down to Chaos Manor to oversee installation of the new and improved system, run twisted pairs of Omninet wires around, and in general improve on communications here. I'm much impressed by the Corvus; I keep hoping the company will mate that big bit-mapped screen to the Modula operating system, but Corvus says it has something even better, or at least as good, which Ramsey will show us when he comes. I'm prepared to be impressed.

I just hope they take the chains off before they let him come.

PC-Write

PC-Write is a full-screen text editor that makes use of many special features of the IBM PC. I haven't tested PC-Write, but I've seen enough of it to know it's a pretty good editor—especially for the price. You can get it for $10, or even for free.

PC-Write is distributed as "Shareware." What this means is that you can buy a copy from the publisher for $10, but that's not the principal means of distribution. Anyone who has a copy is encouraged to give copies to all his friends. The program and its documents are all on disk, so this is quite feasible.

People who get the program and like it are requested to send $75 to Quicksoft, the program's publisher. When you send in the money, you get a printed copy of the document—a marginal improvement over what's on the disk—and an "official registration number." Put the registration number into your copy. Now, when you give copies away, if anyone you've given it to sends in the $75, you'll get a $25 sales commission.

Quicksoft's Bob Wallace says the company's not doing too badly. A number of people have liked the program enough to register it. He's meanwhile writing new programs to distribute this way.

I don't know whether the "shareware" concept will catch on. I encourage the trend.

Tutsim

One program I'm likely to use often has the odd name of Tutsim and comes with a picture of an Egyptian pharaoh. I presume he's King Tut. I have a copy, and when I get a chance I'll wring it out; meanwhile, I saw it work at the Faire, and it was impressive.

Tutsim solves differential equations. It does this by turning your computer into a kind of analog device: that is, you can simulate the various kinds of operational amplifiers some of us older types remember from days long ago. Once you have the analog model set up, Tutsim solves the equations and produces the graphical results.

This probably makes little sense to some readers. Don't worry about it. I'll have a lot more in upcoming columns. Tutsim looks to be a very practical engineer's toolbox, and anyone who has to work with, or teach, differential equations should write Applied i for more information. It might be exactly what you're looking for; certainly it was one of the most unusual items I saw at the Faire.

Rana Systems

I don't recall Rana Systems being at the Faire before, but I may simply have missed it. Since the last show, I've met Fran Mulvania, Rana's director of communications, and we have installed Rana systems, so I tend to notice the company more.

Anyway, the Rana folks were out in force this year with a variety of products. Their flagship item remains the 2.5-megabyte floppy disk that so im-

pressed me last year at NCC. They also make a full line of disk drives for Atari and Apple computers. I've used them, and they're faster and more reliable than the ones Apple and Atari supply.

Rana's monster floppy-disk controller goes into a standard IBM PC slot. It can control standard floppy disks as well as 2.5-megabyte drives (good for an overcrowded PC). I've been using 1.1-megabyte 8-inch floppy disks for some time now, and every time I have to work with smaller disks I miss the big storage capacity. It would be a weird experience to have 5¼-inch disks with a greater capacity than my 8-inch disks!

Rana will shortly have the 2.5-megabyte disks for Apple IIe systems as well. We expect to get one pretty soon. Full report then.

Osborne

Suddenly a lot of people were wearing buttons that said "Osborne is back!" However, if you read the fine print it wasn't so certain.

The people at Osborne had a booth, not as large as the ones they had in the salad days, but large enough and complete with balloons. (Interestingly enough, Kaypro, which is the entry-level system I most often recommend, was in the booth Osborne occupied last year.) The Osborne people had videotapes of Adam Osborne himself telling how wonderful the Osborne computer is. They even had a bunch of computers that looked like the old Executive, until you got close to them.

What they didn't have was order books. No computers were for sale, and no price for the new Osborne PC has been established. This Osborne is different enough from the ill-starred Executive to warrant calling it a new machine. They say it is definitely PC compatible: I saw it run Flight Simulator, which is the program people often use to test PC compatibility. Otherwise, the machine looked a lot like the older Executive.

There are a lot of differences, though. There's an RGB (red-green-blue) color board adapter, an expansion chassis, and a socket for the 8087 math chip.

At last year's Faire, Osborne had patches with the big "barred O" symbol and the words "Osborne—teaching others to be humble." There weren't any of those patches this year.

Zenith's Friends

As usual, Zenith took one of the largest booth areas of the Faire. It doesn't look all that big, because the folks at Zenith always invite certain people to share it with them. For example, Jim Hudson, whose 8087 math board greatly increases 8086 machine capabilities, was there. Jim was showing off his 8087 boards for the Z-100 and the CompuPro. The Z-100 board is especially ingenious: it's an S-100 board with 256K bytes of RAM (random-access read/write memory) and the 8087 both aboard. The 8088 goes on his board, and a header plugs into the motherboard where the 8088 went; the memory connects to the S-100 connector and gets all the decoding and so on there. The Hudson board has a lot of bang for the buck.

Walt Bilofsky's Software Toolworks also shared quarters with Zenith. The Toolworks has changed a bit. Instead of Insta-press flyers, Walt has a big color catalog printed on slick paper. The logo of the blacksmith forging a floppy disk on an anvil is gone, too. For nostalgia buffs, he still distributes software in Ziploc sandwich bags though.

The Software Toolworks used to specialize in Heath/Zenith software, and the company still has a lot for those machines, but most of what I got from Walt this trip is for the IBM PC. I'll report in a later column; meanwhile, those who don't know about the Toolworks ought to get a catalog. Bilofsky sells good stuff at remarkably low prices.

The MPI printer people were also in the Zenith area. Zenith now sells MPI printers. So does Heath in its catalog. The printers say "Zenith" on the outside, but the catalog lists them as MPIs. Pretty honest. I've written about the line before: we have four MPI printers, and we're happy with them all.

Heath/Zenith's New Z-150

The Zenith Z-150 ZPC is its entry into the IBM-compatible arena, and it's an impressive one, so much so that my first thought is that this is probably the PC clone to buy if you want one. We'll be getting one shortly—full report then. It sure has a lot of nice features.

The Z-150 is a desktop, smaller than the IBM. It seems to run everything that the IBM will, right out of the box. We watched Bruce Tonkin put his MyWord word-processing program in the Zenith and run every feature. Rachel Klau, a programmer for Heath, said that people came by through the entire show and ran all their favorite IBM programs without fuss, muss, or bother. While she was saying this, a group of people came over and ran their newfangled 2-D structural modeling program on it. They all applauded when it ran and went away saying that it worked better than on the IBM PC. After Rachel had relaxed (they were still batting 1.000 on IBM compatibility), she told me that the Z-150 was designed from the start to run Microsoft's Flight Simulator, which is in some ways the very best test of IBM compatibility.

It's certainly the only IBM compatible that you can build yourself. If you're skillful with tools and soldering iron, you could save yourself a lot of money. The folks at Zenith showed a prototype of their "portable" (33 pounds!). Alex says it's one of the funkiest machines ever built. It's portable in about the same sense that a 19-inch TV with a handle is portable—with great care you can get it from room to room. To be fair, the Compaq weighs 32 pounds and the IBM portable 30.

Both the table model and the "portable" have eight IBM-type slots and an 8087 socket, and both run at the same speed as the IBM PC. Given the company's quest for absolute compatibility, that's no surprise, but there is no speed-up switch or anything to let the Z-150 cut loose on its own, and that's a bit sad. Still, the machines seem to run absolutely everything that people tried, including MS-BASCOM (Bruce wrote MyWord in BASCOM). The Z-150 uses two half-height 5¼-inch drives.

You can get it with a hard disk, which takes the place of one of the floppy disks. Since it's a full-height hard-disk drive, it sticks down into the cabinet below where the lower half-height drive would normally go. Very slick. The detached keyboard doesn't have quite as nice a touch as the Z-100's keyboard, but it's better than most. The keyboard has moved all the "wrong" position keys on the IBM PC to more reasonable places. It has lighted LEDs (light-emitting diodes) for Caps-Lock, Num-Lock, and Shift-Lock keys.

This is definitely a "Heath/Zenith"

(continued)

machine, in that order. It was developed in St. Joseph, Michigan (Heath's headquarters) by Heath employees. The Zenith Z-100 was developed by Zenith, though of course Heath is famous for its kit versions of computers—including the Z-150 ZPCs. Kit versions usually bear the Heath name and fully assembled ones the Zenith name.

The Z-150's main claim to fame is its color board. It seems 100 percent compatible with IBM color programs and is by far the best PC clone color board I've ever seen. If the folks at Zenith want to sell this board to IBM owners, they'll make a mint. Unlike the IBM, which blinks horribly every time a line is scrolled, Zenith's has (settable!) smooth scrolling that looks good with both graphics and text. In addition, I heard rumors of high-resolution color boards in development. Don't be surprised if the first one looks a great deal like the Z-100's color palette.

One other twist: there's a built-in debugging tracer in ROM that you can access at any time. It shows you what code is being run, what's on the stack, and what's in the registers. You can get to it as long as the machine is listening for interrupts; if not, you'll have to turn it off and on. The lack of a real reset switch, one that *always* works, is the major blemish on an otherwise nearly perfect machine.

Incidentally, don't expect Zenith to suddenly phase out the Z-100 in favor of the Z-150. This is the same Heath that will sell you a knob for a 25-year-old kit tuner out of its warehouse stock. If the company's reputation won't convince you, the sales of the Z-100 should: GSA, the Army, Navy, Air Force, and UPI have all bought more than 5000 each of these machines. It's likely to be *the* machine at the Air Force Academy. The Z-150 is to get Zenith an entry into the market of PC clones, not because Zenith wants to dump the Z-100. A small company looking for a machine to develop PC software on could do a lot worse than buy the H-150 kit.

Speaking of the Navy, I talked to two sailors, one from the *Enterprise*, the other in an LHA helicopter carrier (or Large Hotel, Afloat). Both had Z-100s onboard—there are 23 on the *Enterprise*. Both complained that the power supplies tended to burn out on the Z-100s because of the spikes in shipboard power. Otherwise, they are extremely happy with their Z-100s. Considering that most big shipboard navigation and fire-control computers have just been upgraded to 64K-byte core (!) memory, I can see why! It isn't generally known, but the BB *New Jersey* still uses big mechanical analog integrators for fire control. A Z-100 with a good power filter would be a lot more machine. . . .

Bottom Lines

There was a great deal more to see, including a Japanese import color system using a light pen to do in 265 shades of color what Macpaint does in black and white. The FORTH people handed me a thick stack of books and program disks that are supposed to produce the brand of FORTH described in Leo

(continued)

IBM's "Channel Arrangement"

I'm not much impressed with the IBM PCjr, so I would have ignored the IBM booth, but the folks there had big signs proclaiming their new "network." This looked interesting, and I sent my son Alex off to investigate. Here's his report:

"IBM showed off a new product to tie the PC, PC XT, PCjr, and Portable PC together. It's not a network. It's a 'channel arrangement.' I'm not sure what that is. I can tell you what it is not: a real network. With a raw communication speed of 375K bits per second (bps) and only 64 users maximum, it's not going to compete with Ethernet, Omninet, or Arcnet. To compare, Arcnet and Omninet run at about 1 million bps and Ethernet at about 10 million bps. Those are raw speeds, not equal to the amount of data that can really be sent. Nonetheless, I think the low speed alone means it won't do well, even with the IBM name on it.

"Data is carried on a 75-ohm coaxial (TV) cable. You put a Tee in for every station; that Tee cable can be about 16 feet (5 meters) long. The distance between the farthest stations can be only 1000 meters at most, so IBM's 'channel arrangement' is good only for pretty local communications to start with.

"There are some other problems. IBM doesn't even support all of its own machines; I specifically asked, and no, the company doesn't support the PC XT/370 on this net. Nope, no way to hook up to its own mainframes or non-PCs. Only 10 megabytes can be shared on line; the folks at IBM don't even support multiple hard disks! They said you cannot put a second XT hard drive on the channel.

"There's no true file sharing or record locking (goodbye, shared databases). No DMA (direct memory access), which means that each byte must go through a register (rather than being transferred directly into the receiving machine's memory). This omission is ostensibly because the PCjr doesn't support DMA. (I think that last point is a nail in the coffin of both the jr and the channel arrangement.)

"The IBM employees I talked with stressed how you could run the PCjr with no disk drives by doing an 'IPL'—an old IBM mainframe term meaning Initial Program Load—from the net, making the PCjr a diskless workstation. Perhaps they are attempting to crack the school market with this? This might work if it didn't require a hard disk, but in fact the 'channel arrangement' does require one. I could see a bunch of PCjrs being fed by a single PC XT, but I see no cost savings over PCjrs with a disk. First, you must buy IBM's board and software ($400 in quantity), then you must buy a central PC XT ($5000 and up). A PCjr's extra memory and disk drive are only $600; that's an awful lot of PCjrs to buy to get a cost savings—and there's very little school software for the PCjr right now.

*"**But:** IBM knows all these things. Rumors have it that this isn't IBM's network, but merely an aberration (er, stopgap) to fill in at the moment. All those deficiencies lead me to believe that the folks at IBM are using their customers as paying test sites to de-kink their ideas of what a network should be."*

—Alex Pournelle

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BOOKS REVIEWED

Clapp, Douglas. *Macintosh! Complete*
North Hollywood, CA: Softalk Books, 1984. $19.95

Lu, Cary. *The Apple Macintosh Book*
Bellevue, WA: Microsoft Books, 1984. $18.95

Norton, Peter. *Inside the IBM PC*
Bowie, MD: Brady, 1983. $19.95

Brodie's excellent introduction, *Starting* FORTH. MicroPro has a new 16-bit spelling-correction system called CorrectStar. It has more features than The Word Plus, which I use at present, and I liked it quite a lot; I'll go into more detail on that in my next column.

There were a lot of good speeches and seminars, all well organized. Despite a few glitches, the new Faire management team kept things running far more smoothly than I would have believed they could. Final attendance was a bit over 40,000, down from the 48,000 of last year, but good enough, especially since so many people bought merchandise.

It's still my favorite computer show. ■

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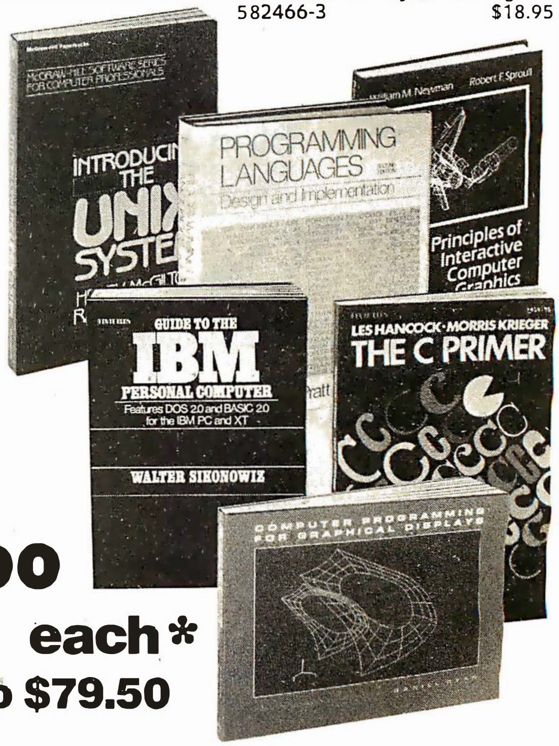
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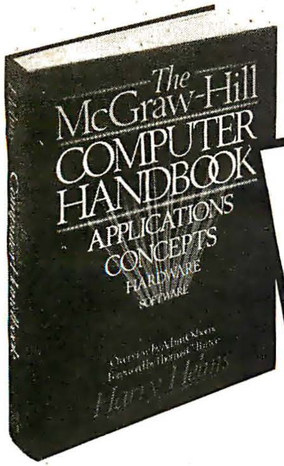
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(continued from page 141)

Ada Compilers for Microcomputers

One of the partial Ada compilers, called Janus Ada, is sold by R&R Software for Z80- and 8088-based machines. I have the 8088 version that operates under MS-DOS. Although the developers of Janus Ada have not developed a full Ada compiler to date, they plan to do so with this compiler. As it stands, the compiler is a powerful tool that can be used to learn some of the features of Ada, but remember that it is not a true implementation of Ada.

To see how a partial compiler differs from a full compiler, I submitted the examples from parts 1 and 2 of this primer to the Janus Ada compiler. In order for these examples to run, I had to make some modifications. In most cases the changes were cosmetic, but in one major aspect the changes were significant because Janus Ada does not support subprograms that can be separately compiled. Each subprogram must be placed in a package and compiled as a package. In Janus Ada, the concept of the main program is more like that of a main package; that is, what Ada's designers considered to be the initialization part of a package becomes the main program. This is not such a bad way to start; it would have been far worse if Janus Ada had only a single procedure as the main program. As it is, Janus Ada supports separate compilation of package specifications and package bodies. A package can also contain several subprograms; all the examples that follow contain only one subprogram per package, however.

The smallest Janus Ada program is

```
--tiny.pkg
--package name must be same
--as file name in Janus
--smallest Janus Ada program
package body tiny is
--main program
begin
--do nothing in main program
  null;
end tiny;
```

To invoke the compiler, the source program was placed on disk B and the compiler on disk A. The command was given on disk A as **A>janus b:tiny**.

Only a compiler writer could understand the information presented, but the message provides a warm feeling that something is going on. Finally this message is displayed:

```
Thank You For Using JANUS/Ada
A>
```

After this, the linker disk is put in disk A, and you type the command **A>jlink b:tiny**, which causes the program to be linked and stored on disk B as **tiny.com**. To execute the program, give the command **A>B:tiny**.

I strongly recommend that the compiler (or at least its scratch files) be put on an electronic disk to speed up the process. If the linker can be left in disk A, it's convenient to create a batch file to make a command sequence that compiles, links, and executes.

The other significant difference is that the name of a package has to match the name of the file where the package is stored. Under MS-DOS, this limits package names to eight characters.

The smallest Janus Ada program with a subprogram is

```
-- example.lib
-- Smallest Ada program with
-- a subprogram in a package

--Specification in Janus Ada
--is in .lib file
package example is
  --subprogram specification
  procedure do_nothing;
end example;

-- example.pkg
-- Smallest Ada program with
-- a subprogram in a package
package body example is
  --subprogram implementation
  procedure do_nothing is
  begin
    null;
  end do_nothing;
end example;

-- small.pkg
-- Main program
with example;
--main program uses subprograms in package
package body small is --main program
  --use must be in declaration part
  use example;
--executable part of main program
begin
  do_nothing;
end small;
```

This program is split across three files: **example.lib** for the package specification of the subprogram, **example.pkg** for the package body of the subprogram, and **small.pkg** for the main program.

Altogether, the packages do not appear very different from standard Ada. Requiring that separate units be in separate files is probably not a bad idea for small computers. It isolates changes to small units of code and keeps compilation times shorter.

Both of the programs to display a message look very much like standard Ada and both display the correct message. Note that Janus Ada does not use the **text_io** package. Instead, various forms of **get** and **put** are built into the compiler.

```
-- hello1.pkg
-- Greet the world
-- Introduce output in Ada
package body hello1 is
begin
  put ("Hello, world!");
  new_line;
end hello1;
```

This version of the program also displays **Hello, world!**

```
-- hello2.pkg
-- Greet the world
-- In another version
package body hello2 is
begin
  put ("Hello");
  put (",");
  put (" ");
  put ("world");
  put ("!");
  new_line;
end hello2;
```

Janus Ada requires that all variables be declared and have predefined types. The main difference between the following program and the standard Ada example is that the input and output routines do not require instantiation.

(continued)

```
put (" a                    the Ada compiler ");
new_line;
put (" s                    the Ada syntax checker ");
new_line;
put (" l                    the Ada library manager ");
new_line;
put         (" Your request? ");
new_line;
end greet;
--receive response
--filtering out tabs, blanks, and carriage returns
procedure get_response (c : out character) is
begin
   c := ' ';
   while c = ' ' or c = ascii.ht loop
      get (c);
   end loop;
exception
   when end_error = >
         c := ascii.eot;
end get_response;
procedure help (help_topic : help_topic_type) is
begin
   case help_topic is
      when ada_help = >
            put (" The ADA command compiles and executes
            the program.");
            new_line;
      when syntax_help = >
            put (" The ADAP command parses an Ada
            program.");
            new_line;
      when library_help = >
            put (" The /LIBFILE=[file] option uses a library.");
            new_line;
      when error_help = >
            put (" Did not understand that. Please rerun the
            program.");
            new_line;
   end case;
end help;
end help_package;

with help_package; use help_package
procedure main is
   c : character;
begin
   greet;
   get_response (c);
   case c is
      when ascii.eot  = > null;
      when 'a'|'A'    = > help (ada_help);
      when 's'|'S'    = > help (syntax_help);
      when 'l'|'L'    = > help (library_help);
      when others     = > help (error_help);
   end case;
end main;
```

First, we establish a package that contains three procedures:

(continued)

```
--var1.pkg
--Introduce variables
package body var1 is

  --declaration for integer variable
  age : integer;

begin

  age := 40;

  put ("This year Sam is ");
  put (age,2);
  put(" years old. ");
  new_line;

end var1;
```

Janus Ada also has subtypes so that the second version of the program appears as

```
--var2.pkg
--Introduce variables and subtypes
package body var2 is

  subtype age_type is integer range 0..99;
  --declaration for age_type variable
  age : age_type;

begin

  age := 40;

  put ("This year Sam is ");
  put (age,2);
  put(" years old. ");
  new_line;

end var2;
```

The control structures for Janus Ada are faithful to standard Ada. The following examples required only minor changes. Since each was a separate program, it was merely a matter of making each into a package body and eliminating the text_io setups. The first program demonstrates the while loop construct.

```
--while1.ada
--The while construct
package body while1 is

  subtype count_type is integer range 1..5;
  count : count_type;

begin

  count := 1;
  while count <= 4 loop
    put (count * 10, 2);
    new_line;
    count := count + 1;
  end loop;
end while1;
```

The second program is another version of the **while** loop construct using the **succ** operation to perform incrementing of the control variable.

```
--while2.pkg
--The while construct
package body while2 is

  subtype count_type is integer range 1..5;
  count : count_type;

begin

  count := 1;
  while count <= 4 loop
    put (count * 10, 2);
    new_line;
    count :=
      count_type'succ(count);
  end loop;

end while2;
```

The following program demonstrates the **for** loop construct.

```
--for1.pkg
--The for construct
package body for1 is

begin

  for count in 1..4 loop
    put (count * 10, 2);
    new_line;
  end loop;

end for1;
```

In Janus Ada, **get** and **put** do differ in the semantics for how input and output are performed. **get** reads the end-of-line character, which makes the copy program easier to understand. The strange construction **end_of_file(standard_input( ))** is left over from a version of Ada before it became standardized. I was not able to use Control-Z as an end-of-file, but Control-C stopped the program. Janus Ada does not have exceptions, so the other version of the program is not possible.

```
--copy1.ada
--Copy input to output
with io,util;
package body copy1 is
  use io,util;

  c : character;
begin

  while not end_of_file(standard_input( ))
  loop

    get(c);
    put(c);

  end loop;

end copy1;
```

The **io** and **util** packages brought into this program have the **end_of_file** and **end_of_line** functions. Other useful input and output functions and procedures in these two packages are provided with the Janus Ada compiler.

The **if** statement is no different from standard Ada, as can be seen in the following examples.

```
-- if1.pkg
-- Illustrate the if
-- and else statements

package body if1 is
  answer : character;
begin

  put (" Do you like Ada so far? ");
  new_line;
  put (" Type y for yes, or n for no: ");
  new_line;

  get (answer);

  if answer = 'y' or answer = 'Y' then
    put (" Glad to hear it!");
  else
    put (" Hope it changes.");
  end if;
end if1;
```

The only major difference in the next example is the fact that the program was in three files because of the separate package for **greet**.

```
--greeting.lib
--greeting for elsif example

package greeting is
  procedure greet;
end greeting;
--greeting.pkg
-- greeting for elsif example
package body greeting is
  procedure greet is
  begin
    put (" Do you like Ada so far?");
    new_line;
    put (" Type y for yes, or n for no: ");
```

(continued)

greet, get_response, and help. The procedure greet presents information on the display as to what the program does in response to user inputs. This is always a good practice, even for more complex programs.

The procedure get_response contains some additional code to make it more user-friendly. Some users of interactive programs type a space (or even an enter or carriage-return symbol) before entering a response, just as someone about to give a talk may blow into the microphone before speaking. Ada refers to the *tab* character as ascii.ht (ht stands for horizontal tab). Since the carriage-return symbol is not returned by get, there is no test for the carriage return. The *exception* is used to denote the end of a transmission (ascii.eot).

After returning from get_response, the value of the character c is tested in a case statement. If it is an end_of_file, the program exits from the case statement doing nothing, and then it exits the program at the bottom of the procedure. This is the usual way of terminating an Ada program. The other calls result in the display of some of Ada's on-line help features or display a message to the user. Although you could use a put at the point of the call to the help procedure, the example illustrates the use of the case statement calling another program.

The case statement evaluates the expression following the keyword case. The expression must evaluate to one of the enumerated types, such as character. After evaluation, the statement transfers to the when clause that matches the case value, resuming execution with the statement following the symbol => . For example, if c contains an *a* or an *A*, it matches the first case, and the call will be to display the help information for the Ada compiler. The bar symbol (|) can be read as an or between values such as *a* or *A*. If none of the when clauses that contain character values match the value in c, then the others clause is taken.

Ada requires that a when clause be listed for each possible value of the expression in the case statement or that a when others clause be used. This is to help prevent a common programming mistake called *missing logic*.

POINTERS

Pointers, often a source of difficult bugs in programs, are sometimes considered mysterious or tricky. Ada eliminates many of the problems associated with pointers by providing protection against some of the common bugs arising from the misuse of pointers. Ada does not even call its pointers by the name pointers. Instead it calls them *access types*. Nevertheless, variables of an access type contain addresses as their value just as integer type variables contain integers as legal values. The following example is a version of the Hello, world! program (from part 1) rewritten to introduce access types.

```
--access.ada
--To introduce access types
with text_io; use text_io;
procedure main is
   type message_access is access string;          --A
   message : message_access;                      --B
begin
```

(continued)

```
   message := new string'(" Hello, world! ");                --C
   put (message.all);                                        --D
end main;
```

The declaration in line A states that **message_access** is an access type that can point to strings. Then in line B, a declaration is made that **message** is an access variable; hence, **message** can point to a string. In line C, the **message** pointer is assigned to the string created by the **new string' (" Hello, world! ")**. To picture this operation, consider it as represented in figure 1. Line D then displays the message with **message.all**, which indicates that everything pointed to by **message** is to be used.

```
--message.ada
--Copy from access string to string
with text_io; use text_io;
procedure main is
   type message_access is access string;
   small : constant := 20;
   original : message_access;
   copy     : string (1..small);
procedure string_copy
       (from_string : message_access;
        to_string : out string) is
   begin
     to_string := (1..to_string'length => " ");              --A
     for i in from_string.all'range loop                     --B
       to_string(i) := from_string.all(i);                   --C
     end loop;
   end string_copy;
begin
   original := new string'(" This will repeat. ");
   string_copy (original, copy);
   put (original.all);                                       --D
   put (copy);                                               --E
end main;
```

The **string_copy** procedure shows that strings can be operated on by pointers and can be stored in arrays. In fact, the string type is predefined in Ada to be **type string is array (positive range < >) of character;**.

In line A, the procedure sets **to_string** to all blanks with an aggregate expression. It specifies that as many blanks as designated in the aggregate are to be assigned to **to_string**. In line B, a **for** loop is set to address every element in the string by the use of the **'range** attribute. The loop parameter i picks out the individual characters in line C, transferring them from the string pointed to by **original** into the string copy.

In the body of the main program, **original** is set to point to a string. Then the procedure **string_copy** is called. Finally, in lines D and E, the original and the copy are displayed.

The following example performs the same operations without a loop. In Ada, assignment statements between strings of the same length are possible.

```
--message2.ada
--Copy from access string to string
with text_io; use text_io;
```

```
procedure main is
  type message__access is access string;
  small : constant := 20;
  original : message__access;
  copy     : string (1..small);
  procedure string__copy
        (from__string : message__access;
        to__string : out string) is
    length : integer;
  begin
    length := to__string'length:                      --A
    to__string := (1..length = > ");                  --B
    length := from__string.all'length;                --C
    to__string (1..length) := from__string.all;       --D
  end string__copy;
begin
  original := new string'(" This will repeat. ");
  string__copy (original, copy);
  put (original.all);
  put (copy);
end main;
```

The assignments in lines A and B blank out the copy string. The length of the destination string is determined in line C. The assignment in line D copies the entire string in a single assignment statement to the copy string. Of course, Ada will detect an error if the original string is longer than the space set aside for the copy. We can test the lengths of the two strings to prevent an error.

Let us now look at the program **weekday**, in which a function returns a character string given an integer. In line A, **day__type** is declared to be an array that is 8 long, having the index values 0 to 7. Note that indices can start with 0, 1, or any other enumeration value. Each element in the array saves a string. It could also save a pointer to a string but, in this example, it is better to work directly with the strings.

```
--weekday.ada
--return name of weekday
with text__io; use text__io;
procedure main is
  type day__type is
    array (integer range 0..7)
          of string (1..9);                          --A
  day : day__type :=                                 --B
        ( "Oppsday   ",
          "Monday    ",
          "Tuesday   ",
          "Wednesday",
          "Thursday  ",
```

(continued)

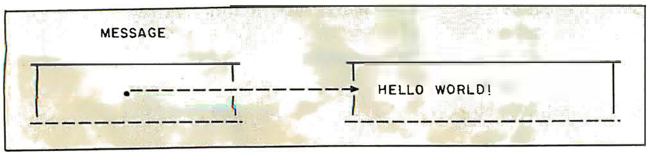
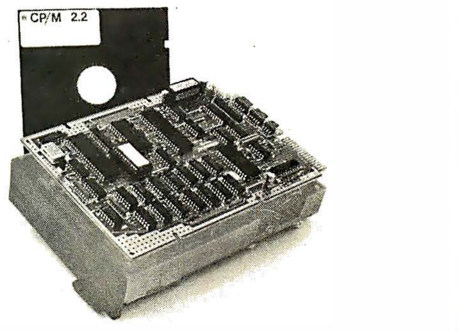


Figure 1: *A pictorial representation of the "Hello, world!" program on page* 389.



```
    new_line;
  end greet;
end greeting;

-elsif1.pkg
- Illustrate use of elsif
with greeting;
package body elsif1 is
- Illustrate use of if
- and elsif and else
  use greeting;

  answer : character;

begin
  -greet the user
  greet;
  get (answer);

  if answer = 'y' or answer = 'Y' then
    put (" Glad to hear it! ");
    new_line;
  elsif answer = 'n' or answer = 'N' then put
    (" Sorry to hear that. Hope it changes. ");
    new_line;
  else
    put(" I don't understand ");
    put (answer);
    put(" . ");
    new_line;
  end if;

end elsif1;
```

The exit statement is also the same as in standard Ada. The version that follows makes use of the **end_of_file** construct to exit the program. I am not sure if Control-C is the right end-of-file command, but it gets you out of the program.

```
-greets.lib
-greeting specification
package greets is
  procedure greet;
end greets;

-greets.pkg
-greeting implementation
package body greets is
  procedure greet is
  begin
    put(" If you type a certain letter ");
    new_line;
    put(" I'll congratulate you for guessing
    it. ");
    new_line;
    put(" If you get bored, type control-c
      instead. ");
    new_line;
  end greet;
end greets;

-exit1.pkg
-Illustrate the if and exit statements
with io, util, greets;
package body exit1 is
  use io, util, greets;
  c: character;
begin
  greet; -display a greeting to the user
  while not end_of_file(Standard_input( ))
  loop
    get(c);
    if c = 'e' then
      put("^-You guessed it! Congratula-
      tions! ");
      new_line;
      exit;
    end if;
  end loop;
end exit1;
```

The other version of the exit example program uses the same packages as before.

```
-exit2.pkg
-Show how to eliminate
-an exit statement

with greets, io, util;
package body exit2 is
  use greets, io, util;
  --initialize c to blank
  c: character := ' ';
begin
-display a greeting to the user
  greet;
  while c /= 'e' and not end_of_file
  (standard_input( )) loop
    get(c);
    if c = 'e' then
      put("^-You guessed it! Congratula-
      tions! ");
      new_line;
    end if;
  end loop;
end exit2;
```

This version of Janus Ada does not support exceptions or aggregates and requires the use of packages for the main program and for any subprograms. This is an appropriate structure for subprograms that in most cases should be placed in packages.

The following program copies characters until an end-of-file marker is reached. **end_of_file** is defined in a package named **io**; the input and output functions **get** and **put** are built into the compiler. The **standard_input** function is in the package **util**. The program is in three files: **copy.lib** for the package specification that names the subprogram in a procedure specification, **copy.pkg** for the package implementation that defines the subprogram, and **copies.pkg** for the main program that calls the subprogram **copy**.

The subprogram **copy_in_out** actually makes more sense than in the full Ada example, which needs special handling to store the carriage return and seems to require an exception to handle the end-of-file. A simple **while** loop continues until an end-of-file condition is reached.

```
--copy.lib
--Copy input to output
package copy is
  procedure copy_in_out;
end copy;

-copy.pkg
-Copy input to output
with io, util;
package body copy is
  procedure copy_in_out is
    use io, util;
    c: character;
  begin
    while not end_of_file(standard_input( ))
    loop
      get(c);
      put(c);
    end loop;
  end copy_in_out;
end copy;

-copies.pkg
_main program to call copy_in_out
with copy;
package body copies is
  use copy;
begin
  copy_in_out;
end copies;
```

The following set of packages reads in a line until it reads either an end-of-file marker or a carriage return. The line read in is then displayed. The main program is in **lines.pkg**; the subprograms are **get_my_line** and **put_my_line**, packaged in **myline.**.

```
--myline.lib
--read a line and display a line

package myline is

  limit : constant := 80;

  type string_type is array (1..limit)
  of character;
  subtype index_type is integer range 0..limit;

  procedure get_my_line (line : out
  string_type;
      length : out index_type);
```

(continued)

```
          "Friday      " ,
          "Saturday    " ,
          "Sunday      ");
  function weekday (number : integer)
          return string is                                   --C
     d : string (1..9);
  begin
     if number < 1 or number > 7 then
        d := day (0);
     else
        d := day (number);
     end if;
     return d;
  end weekday;
begin
  put (" I was born on a " & weekday(4));
end main;
```

In line B, the variable **day** is declared to be of type **day_type**; all eight elements of the array are set by an aggregate. Day (0) is **"Oppsday "** and day (7) is **"Sunday "**.

The function **weekday** inputs an integer number and returns a string. If the value of the parameter falls between 1 and 7, the returned value is the string that names the appropriate day. If the number falls outside the bounds, the value for **"Oppsday "** is returned.

The main program causes the program to display **I was born on a Thursday**. The **&** in the **put** statement is an operator that joins the two strings together.

If you don't mind giving up lowercase letters in your output, Ada has a way of displaying strings directly from integers.

```
--weekday2.ada
--display weekday value using image attribute
with text_io; use text_io;
procedure main is
  type day_type is
     (Monday, Tuesday, Wednesday, Thursday,
      Friday, Saturday, Sunday);                             --A
  week_day : day_type;                                       --B
begin
  week_day := day_type'val(3);                               --C
  put (" I was born on a " &
        day_type'image(week_day));                           --D
end main;
```

Line A defines **day_type** to have a set of 7 values, Monday through Sunday. Line B defines **week_day** to be of the type **day_type**. This enables **week_day** to take on any of the seven names of the days of the week.

In line C, **week_day** is set to an attribute of the type **day_type**. This attribute, **'val**, returns the name of the value in the specified position. In this case, the value of 3 yields **Thursday**. Line D displays the result that combines the message string with another useful attribute of **day_type**. This attribute, **'image**, returns a string representing the name of **week_day** so it can be displayed. The output from this program is **I was born on a THURSDAY**.

Note that **image** provides only an uppercase representa-

(continued)

```
   procedure put_my_line (line : in
   string_type;
         length : in index_type);

end myline;

--myline.pkg
with io, util;
package body myline is
   use io, util;
   procedure get_my_line (line : out
   string_type;
         length : out index_type) is
     c : character;
   begin
     for i in 1..limit loop
       get (c);
       line (i) := c;
       length := i;
       exit when end_of_line (standard_
       input( ));
       exit when end_of_file (standard_
       input( ));
     end loop;
   end get_my_line;
   procedure put_my_line (line : in
   string_type;
         length : in index_type) is
   begin
     for i in 1..length loop
       put (line(i));
     end loop;
     new_line;
   end put_my_line;
end myline;

--lines.pkg
--line functions test
with myline;
package body lines is
   use myline;
   my_line : string_type;
   my_length : index_type;

begin

   get_my_line ( my_line, my_length );
   put_my_line ( my_line, my_length );

end lines;
```

In compiling this program, the compiler was invoked as A>janus b:myline.lib to first compile the package specification for the myline package. Then the compiler was invoked a second time with A>janus b:myline.pkg to compile the package body for the myline package. The third invocation of the compiler, A>janus b:lines.pkg, compiled the main program. After the message Thank You For Using JANUS/Ada, the command A>jlink b: lines caused the program to be linked and stored on disk B as lines.com. The program was executed with the command sequence

```
A>time
A>b:lines
This is some normal data.
A>time
```

to give some indication of the time taken to load and execute the program (including the time taken to type the sentence). It took less than 20 seconds, most of which was spent loading the program and typing the message. The program appeared to operate instantaneously, as it should for such a simple program.

The example that shows the case statement was also rewritten in Janus Ada. It could filter out blanks only. When I tried to establish a loop with end_of_line, I had to type the character I wanted twice. It appeared that the end_of_line function swallowed a character. Otherwise, the program is not much different than the full Ada version.

```
--help.lib
--Demonstrate case statement
with io, util;
package help is
   --send instructions to display
   use io, util;
   --make up for missing ascii character
   package
   eof : constant character :=
                  character'val(26);
   procedure greet;
   --receive response
   --filtering out tabs, blanks, and
   --carriage returns
   procedure get_response (c : out character);
   --show help messages
   type help_topic_type is (ada_help,
     syntax_help, library_help, error_help);
   procedure get_help (help_topic :
     help_topic_type);
end help;
--help.pkg
with io, util;
package body help is
   use io, util;
   --send instructions to display
   procedure greet is
   begin
     put (" On line help for Ada
     programmers ");
     new_line; new_line;
     put (" Type      For help about ");
     new_line;
     put (" ------------------------------------------ ");
     new_line;
     put (" a         the Ada compiler ");
     new_line;
     put (" s         the Ada syntax checker ");
     new_line;
     put (" l         the Ada library manager ");
     new_line;
     put (" Your request? ");
     new_line;
   end greet;
   --receive response
   --filtering out blanks
   procedure get_response (c : out character) is
   begin
     c := ' ';
     while c = ' ' loop
       get(c);
         if end_of_file (standard_input( ))
         then
           c := eof;
           exit;
         end if;
       end loop;
     end get_response;
     procedure get_help (help_topic : help_
       topic_type) is
     begin
       case help_topic is
         when ada_help =>
           put (" The ADA command com-
           piles and executes the program.");
           new_line;
         when syntax_help =>
           put (" The ADAP command parses
           an Ada program. ");
           new_line;
         when library_help =>
           put (" The /LIBFILE=[file] option
           uses a library. ");
           new_line;
         when error_help =>
           put (" Did not understand that.
           Please rerun the program.");
           new_line;
       end case;
     end get_help;
   end help;
--main.pkg
with help;
package body main is
   use help;
   c : character;
begin
   greet;
   get_response (c);
   case c is
     when eof       => null;
     when 'a'|'A'   => get_help (ada_help);
     when 's'|'S'   => get_help (syntax_
                       help);
     when 'l'|'L'   => get_help (library_
                       help);
     when others    => get_help (error_help);
   end case;
end main;
```

Janus Ada also has access types, as demonstrated in the following program. The main difference between this program and the full Ada version is the Janus compiler won't allow allocation of an object at the same time as setting the object. This restriction is very common in partial compilers. As a result, it requires two statements, whereas one is sufficient in full Ada. Another difference not obvious in this program is that strings in Janus Ada are not fixed-length strings but variable-length strings. In the previous examples, I declared a type called ada_string, which is more like a true string. But I could not use the type in this example and set it to a string literal, so I used Janus strings.

```
--point.pkg
--To introduce access types
package body point is
  type message_access is access string;
  message : message_access;
begin
  message := new string;
  message.all := " Hello, world! ";
  put (message.all);
end point;
```

It's possible to gain access to individual characters in a string pointed to by an access type variable through such notation as from_string.all(i). However, with Janus's dynamic strings, it is not possible to refer to an element of the string until it is there. Hence, I did just the second version of the program, which eliminates the for loop. Since the string_copy subprogram is just one statement, it does not seem very worthwhile as a subprogram.

```
--message.pkg
--Copy from access string to string
with strlib;
package body message is
  use strlib;
  type message_access is access string;
  original : message_access;
  copy     : string(20);
  procedure string_copy
        (from_string : in message_access;
         to_string : out string) is
  begin
        to_string := from_string.all;
  end string_copy;
begin
  original := new string;
  original.all := " This will repeat. ";
  string_copy (original, copy);
  put (original.all);
  put (copy);
end message;
```

The original version of the weekday program uses aggregates to initialize the array day. These were changed to assignment statements that assigned the elements of the array individually. The second version of the full Ada program uses the image attribute, and the third version uses an exception handler. Equivalent versions could not be written in Janus Ada because these features are not part of Janus Ada.

```
--week.pkg
--return name of weekday
package body week is
  type day_type is
    array (integer range 0..7) of
          string (9);
  day : day_type;

  function weekday (number : integer)
                  return string is
    d : string(9);
  begin
    if number < 1 or number > 7 then
      d := day (0);
    else
      d := day (number);
    end if;
    return d;
  end weekday;
begin
  day(0) := "Oppsday   ";
  day(1) := "Monday    ";
  day(2) := "Tuesday   ";
  day(3) := "Wednesday";
  day(4) := "Thursday  ";
  day(5) := "Friday    ";
  day(6) := "Saturday  ";
  day(7) := "Sunday    ";

  put (" I was born on a " &
       weekday(4));
end week;
```

The output from the program is **I was born on a Thursday.**

Janus Ada provides for records, as shown in the following program. It makes you appreciate the use of aggregates in full Ada.

The missing 'range attribute requires that the loop be changed if the number of items in the list is increased. The output from the program is the same with the full Ada program.

```
--list.pkg
--Show an array of records
package body list is

  type list--type is
    record
      name   : string (12);
      number: string (12);
    end record;
  type phone_list_type is
    array (1..3) of list_type;
  phones : phone_list_type;
begin
  phones(1).name :=   "Sabina Saib  ";
  phones(1).number := "805-964-7724";

  phones(2).name :=   "Weather      ";
  phones(2).number := "805-962-6878";

  phones(3).name :=   "Time         ";
  phones(3).number := "805-966-0611";

  for i in 1..3 loop
    put (phones(i).name);
    put (phones(i).number);
    new_line;
  end loop;
end list;
```

These simple examples show that Janus Ada, while not a full Ada, bears a close resemblance to Ada. I leave you to judge how close the resemblance is. We can hope that future versions will come closer to Ada.

What these examples do not show are the nice error messages and diagnostics that Janus Ada provides. At one point in testing the examples, I omitted a semicolon and the compiler asked me if I wanted it to insert one and continue. I let it continue; it compiled and executed correctly. In another instance, I was in violation of a constraint and the run-time system told me which line in which subprogram caused the error. It also told me which parent program called the subprogram and at which line the call was made. These features make me hope that this compiler will become a full Ada compiler.

tion of the name. If you use a value outside the range 0 to 6, Ada causes an error, called an *exception*, to occur. You can refine this example by handling the exception.

```
--weekday3.ada
--display weekday value using image attribute
--contains exception handler
with text_io; use text_io;
procedure main is
  type day_type is
    (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday,
```

(continued)

```
    Sunday);
  week_day : day_type;
begin
  week_day := day_type'val(3);
  put (" I was born on a " &
        day_type'image(week_day));
  exception                                   --A
  when others =>
        put (" Opps, something was wrong! ");
end main;
```

The program, down to the exception in line A, is the same as before. If something goes wrong, the statement following the => causes the message **Opps, something was wrong!** to be displayed.

Records

Ada records are very much like Pascal records. In the example that follows, line A defines **list_type** to be a record with two fields: **name** and **number**. Each record is a string. Both **name** and **number** are 12 characters long.

Line B defines a type that is an array of three records. Line C defines an object that can be used to store up to three names and numbers. The object is initialized with an aggregate giving the three names and numbers.

The **main** program simply lists the information stored in the record. The **for** loop in line D uses a valuable attribute of **arrays 'range**. If the array was changed to 25 or 100 instead of 3, the loop would not need to be changed.

The **put** statements in lines E and F show how individual elements in the array, and then individual fields in the record, are referred to with a dot notation.

```
--Show an array of records
with text_io; use text_io;
procedure main is
  type list_type is
    record                                    --A
      name : string (1..12);
      number : string (1..12);
    end record;
  type phone_list_type is
    array (1..3) of list_type;                --B
  phones : phone_list_type :=                 --C
        (("Sabina Saib ", "805-964-7724"),
         ("Weather     ", "805-962-6878"),
         ("Time        ", "805-966-0611"));
begin
  for i in phones'range loop                  --D
    put (phones(i).name);                     --E
    put (phones(i).number);                   --F
    new_line;
  end loop;
end main;
```

When run, the preceding program displays:

```
Begin Ada execution

Sabina Saib 805-964-7724
```

```
Weather    805-962-6878
Time       805-966-0611

  Execution complete
  Execution time: 12 seconds
  I-code statements executed: 44
```

Going Further in Ada

Although you have seen some complete Ada examples and should be able to write your own Ada programs, you can learn much more about the language from the numerous textbooks on the language. Some of these texts are listed in the bibliography.

You will also need access to an Ada compiler. The most comprehensive compilers are on large machines, such as the NYU Ada/Ed on VAX 11/780 computers. There are also some promising microcomputer compilers, such as Janus Ada from R&R Software (see the text box beginning on page 386). Whatever compiler you use, try some of the simple examples from this article and then add your own applications with help from a textbook.

Eventually you will want to have your own *Ada Language Reference Manual*, available from the U.S. Government Printing Office, as well as from several commercial publishers. Be sure to get the 1983 ANSI standard version of the manual instead of a preliminary version. ■

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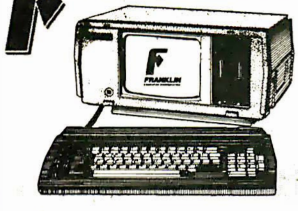
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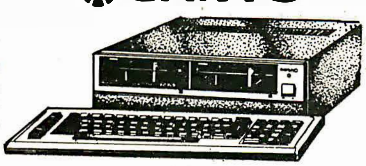


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(continued from page 145)

tively acknowledge the expected command. The potential problem occurs in either the Receive Init state or when a Kermit server is waiting for a command. In either case, Kermit won't know whether communication has begun if the other side's initial packet was lost. Kermit can't assume the other side will time out and retransmit, so it must check periodically by sending a NAK for packet zero. If Kermit gets no response, it assumes nothing has happened yet and goes back to sleep for a while.

But sending periodic NAKs opens the door to the buffering problem. Some systems buffer input for a device; when a program isn't looking for input, some or all the input is saved by the computer for future requests. This can cause problems when talking to a Kermit server or sending a file to a Kermit in receive wait. If some time has elapsed since activating the remote Kermit sending the file and escaping back and starting up the local Kermit, a number of NAKs may have accumulated in the local Kermit's input buffer, so *clear the input buffer at the beginning of a transfer.*

If the input buffer is not cleared, the local Kermit will think the remote side is having trouble receiving the first packet. In an effort to get the packet through, it will be sent again; this repeats for every NAK waiting in the input buffer. By the time the first ACK is finally encountered in the buffer, a number of duplicates of the first packet will have been sent out. If this number exceeds the NAK threshold, the connection will be broken. If not, however, the second packet will be retransmitted once for each of the extra ACKs the remote Kermit correctly sent for the duplicate first packets. This can continue throughout the file transfer, causing each packet to be sent many times. So, *clear the input buffer after reading each packet.* Any computer that buffers its input should clear its input buffer before the transfer and after each packet that arrives successfully. But since not all systems provide a clear-buffer function, we may add our last rule: *discard redundant* ACKs.

In the situation just described, the first packet would be sent out multiple times, once for each buffered NAK. Upon receipt of the first ACK, the second packet would go out, but the next response would be another ACK for the first packet; by the last rule, Kermit would simply take in the redundant ACK, ignore it, and look for the next ACK, until it got the desired one, in violation of the spirit of the first rule.

If we allowed ourselves to violate the first rule, we could add another rule, *an* ACK *for packet n also acknowledges all previous packets,* as is done in some network protocols, allowing data packets to be sent in a continuous stream. Kermit cannot use this rule for many reasons: sequence-number wraparound, buffer overflows, and locking out half-duplex systems (how can you negatively acknowledge a bad packet if you can't get control of the line?). Thus, if we violate the first rule, it must be only in a very minor way.

Listing 1: A *sequence of packets from an actual file transfer. Comments are on the right side or in parentheses.*

^A) SH(@-#^	Send Init
^A) YH(@-#%	ACK for Send Init
^A+!FMOON.DOC2	File header
^A#!Y?	ACK for file header
^AE"D No celestial body has required J	First data packet
^A#"Y@	ACK for first data packet
^AE#Das m%%%uch labor for the study of its#	Second data packet, bad
^A##N8	NAK for second data packet
^AE#Das much labor for the study of its#	Second data packet again
^A##YA	ACK for second data packet
^AE$D#M#Jmotion as the moon. Since ClaA	etc . . .
^A#$YB	
(many packets omitted here)	
^AD"Dout 300 terms are sufficient.#M#JU	Last data packet
^A#"Y@	ACK for last data packet
^A##ZB	EOF
^A##YA	ACK for EOF
^A#$B+	EOT
^A#$YB	ACK for EOT

AN EXAMPLE

A sequence of packets from a real file transfer is shown in listing 1. Each packet starts with Control-A, shown as ^A. In the first packet, we see following the Control-A the packet length ")" (41 less 32, or 9) followed by the packet type, S (Send Init), and then by the appropriate parameter declarations: maximum packet length is H (72 − 32 = 40), time-out is "(" (40 − 32 = 8), number of padding characters is 0 (space = 32 − 32 = 0), the padding character is 0, end-of-line is "−" (45 − 32 = 13, the ASCII value of a carriage return), the control-quote character is "#", and the remaining fields are omitted, defaulting to appropriate values. The final character ("^") is the single-character checksum, computed as follows (all numbers and computations are in octal, and "sp" represents a space):

```
)     sp    S     H     (     sp
51 + 40 + 123 + 110 + 50 + 40 +
@     -     #
100 + 55 + 43 = 674
674 + (674/300) = 676
676 AND 77 = 76;
char(76) = 76 + 40 = 136 = "^"
```

The receiver acknowledges with its own parameters, which are the same. Then comes the file header, the file, EOF, and EOT. One data packet was corrupted by a burst of "%" characters, negatively acknowledged, and retransmitted.

PERFORMANCE

For text files (documents or program source), assuming an average line length of 40 characters with lines separated by a carriage return/linefeed pair, the only control characters normally found in the text file, we see about 5 percent overhead for prefixing of control characters. Assuming no line terminators for packets (although one or both sides may require them), no retransmissions or time-outs, and no time wasted for the line to turn around between packet and response, for an average packet length *p*, using a single-character checksum, the Kermit protocol overhead consists of five control-field characters in the data packet, five characters in the acknowledgment

packet, and $0.05p$ for control-character quoting.

This gives $10/p + 0.05$ overhead. A packet length of 40 gives 30 percent overhead. If p is 96 (the maximum), there is about 15 percent. These figures will vary with the average line length and the frequency of other control characters (like tabs and formfeeds) in the file and will go up with immediate retransmissions—and way up with delayed retransmissions. For binary files, the quoting overhead will be higher. But transmission overhead can also go down dramatically if prefix encoding is used for repeated characters, depending on the nature of the data (binary data containing many zeros, highly indented or columnar data, or program text will tend to benefit). Each file transfer also gets a fixed overhead for the preliminary (Send Init, File Header) and terminating (EOF, EOT) packets.

If the mainframe end of a connection is heavily loaded, it may take considerable time to digest and process incoming characters before replying. On half-duplex mainframes, a pause may occur between sending and receiving, even if the load is light; this might be used to advantage by preparing the next packet in advance while waiting for the current ACK. Another problem may occur on heavily loaded mainframes—undesirable time-outs. Time-outs are intended to detect lost packets. A heavily loaded system may take longer than the time-out interval to send a packet. For this reason, mainframe Kermits should take the requested time-out interval only as a minimum and should adjust it for each packet based on the current system load, up to a reasonable maximum.

A noisy line has a greater likelihood of corrupted packets and therefore of retransmission overhead. Performance can be improved by reducing the packet length (and thus the corruption probability of any particular packet) and the amount of time required to retransmit it. A Kermit program can unilaterally adjust the packet length according to the number of retransmissions that are occurring. Short packets cut down on retransmission overhead; long packets cut down on character overhead.

THE USER INTERFACE

Kermit was designed from a mainframe perspective. Like many mainframe programs, Kermit issues a prompt, the user types a command, Kermit executes the command and issues another prompt, and so on until the user exits from the program. Much care is devoted to the command parser, even on microcomputer versions. The goal is to provide English-like commands composed of sequences of keywords or operands, with abbreviations possible for any keyword in any field down to the minimum unique length and with "?" help available at any point in a command. Not all implementations need follow this model, but most do.

The basic commands are SEND and RECEIVE. These allow most Kermits to exchange files. Operands can be the name of a single file or a file-group designator (e.g., with wildcards) to transmit multiple files in a single operation. Although some systems may not provide wildcard file processing, the Kermit protocol allows it.

The CONNECT command provides the mechanism for logging in and typing commands at the remote host, which is necessary in order to start the Kermit on that side. The CONNECT facility provides character-at-a-time transmission, parity selection, remote or local echoing, and the ability to send any character, including the escape character that must be used to get back to the local Kermit. However, no error detection or correction occurs during CONNECT, just as none normally occurs between an ordinary terminal and a host.

When two systems are dissimilar, a SET command is provided to allow them to accommodate each other's peculiarities, for instance, SET PARITY ODD to add odd parity to all outbound characters or SET LOCAL-ECHO to do local echoing when connected as a terminal to a half-duplex system. The SET command must sometimes be used to supply information to the target system on how to store an incoming file with respect to block size, byte size, record format, and record length.

Most Kermit implementations take special care to reassure the user during file transfer. The names of the files being transferred are shown, and a dynamic display is made of the packet traffic, showing successful transmission of packets as well as time-outs and re-

(continued)

transmissions. Messages are issued when the user connects to the remote system or escapes back from it, and Kermit prompts identify the implementation. Helpful error messages are displayed when necessary; these may emanate from either the local or the remote system. The final disposition of the transfer is clearly stated: complete or failed.

The actions required of the Kermit user depend upon the degree to which the Kermit programs involved have implemented the specification. Minimal implementations require that the user connect to the remote host, start Kermit there, issue a SEND (or RECEIVE) command, escape back to the local machine, and issue the complementary RECEIVE (or SEND) command. All this must be done for each transfer. More advanced implementations allow the remote side to run as a server and to take all its instructions in special command packets from the local Kermit; all the user has to do on the remote end is make the initial connection to start the server. The server will even log itself out upon command from the local Kermit. A minimal server can process commands to send files, receive files, and shut down.

See listing 2 for an example of a session in which the user of an IBM PC transfers files from a DECSYSTEM-20. The actions shown are required for minimal Kermit implementations.

The session is somewhat simpler when the remote Kermit is being run as a server. The user must still use CONNECT, log in, and start Kermit on the remote end but need never again use CONNECT to issue subsequent SEND, RECEIVE, EXIT, or LOGOUT commands, even though many transactions may take place. All actions can be initiated from the PC.

Advanced Features

An optional feature of the Kermit protocol is a special packet designed to express the attributes of a file in a compact and generic manner. The receiver may either attempt to use the attributes to store the incoming file, or archive them for later use. Attributes include not only file characteristics but also the intended disposition—store, print, submit for batch processing, send as mail, etc. Other optional features include mechanisms for gracefully interrupting, delaying, or suspending operations in progress; alternate forms of packet-data encoding; filename conversion; local file management; raw-data transmission and capture; command-macro definition; etc.

Although Kermit was never intended to fulfill the role of a general-purpose network server, its design has made it simple to add new functions. A Kermit server can accept commands in packets from a remote Kermit. The basic commands are for sending or fetching files and for shutting down the server. Other commands may require the display of text at the user's terminal, which is controlled by the local Kermit. For example, a directory listing could be requested; the resulting text is sent back to the local Kermit exactly as if a file were being transferred, except the destination is the user's screen rather than a disk file. With this ability in place, it is possible to implement all sorts of commands, for instance, to delete a file, show who's logged in, inquire about disk space, verify access to a directory, submit batch jobs, send messages, and so forth.

The ability of the Kermit server to perform host functions can be added very simply under certain operating systems. For instance, under UNIX, Kermit can "fork" a shell with commands to perform any function possible under UNIX, redirecting the standard output through a process (Kermit itself) that encapsulates it into Kermit packets and sends it along.

A server with these capabilities could provide convenient access to a timesharing system by users at personal workstations, without requiring the users to be directly involved with the host. If, for instance, workstations had dedicated connections to a host, and the host had dedicated Kermit servers for each such line, users could get access to and manage their host files completely by commands typed at the workstation. Taking this idea one step further,

Listing 2: *A sample session that transfers a file between an* IBM *Personal Computer and a* DEC *mainframe. The parts the user types are in italic and comments appear on the right or in parentheses. Everything else is system typeout.*

```
A>kermit                          ! Run Kermit on the PC.
Kermit V1.20

Kermit-86>                        ! This is the Kermit prompt for the PC.
Kermit-86>connect                 ! Connect to the DEC-20.
[Connecting to host. Type CTRL-]C to return to PC.]

                                  ! You are now connected to the DEC-20.
Columbia University CU20B         ! The system prints its herald.
@terminal vt52                    ! Set your terminal type (optional).
@login my-id password             ! Login using the normal login method.

(The DEC-20 prints various messages.)

@kermit                           ! Run Kermit on the DEC-20.
Kermit-20>                        ! This is Kermit-20's prompt.
Kermit-20>send *.for              ! Send all FORTRAN files.
^]c                               ! Type the escape sequence to return to the PC.
[Back at PC.]
Kermit-86>receive                 ! Tell the PC that files are coming.

(The progress of the transfer is shown continuously on the screen.)

Transfer Complete.
Kermit-86>connect                 ! Get back to the DEC-20.
[Connecting to host. Type CTRL-]C to return to PC.]
Kermit-20>exit                    ! Get out of Kermit-20.
@logout                           ! Logout from the DEC-20.

Logged out Job 55, User MY-ID, Account MY-ACCOUNT, TTY 146,
  at 24-Apr-84 15:18:56, Used 0:00:17 in 01:21:55

^]c                               ! Now, escape back to the PC
[Back at PC.]
Kermit-86>exit                    ! and exit from the PC's Kermit.
```

the workstation system software could be modified to make the whole process transparent by incorporating the Kermit protocol in its file access logic—fetching and updating host files as necessary behind the user's back. Since the demands placed on a host by Kermit are relatively modest, many simultaneous users could probably be serviced in this way. This approach could be a relatively painless entry into the distributed, networked environment of tomorrow; when local-area-network protocols become mature and the hardware economical and widespread, Kermit can be replaced by the real thing. But for the ordinary computer user for whom dedicated connections are impractical, do-it-yourself Kermit, or some similar facility, will be a valuable tool for years.

Table 1: *The computers and operating systems that the Kermit protocol is available on and the computer language the program is written in.*

Machine	Operating System	Language
DECsystem-10	TOPS-10	MACRO-10
DECSYSTEM-20	TOPS-20	MACRO-20
IBM 370 Series	VM/CMS	IBM Assembler
VAX-11	VMS	Bliss-32
VAX, SUN, PDP-11, etc.	UNIX	C
PDP-11	RT-11, RSX, RSTS	MACRO-II
8080, 8085, or Z80	CP/M-80	8080 ASM
8086, 8088	MS-DOS, CP/M-86	MASM, ASM86
Apple II 6502	Apple DOS	DEC-10/20 CROSS

CONCLUSIONS

The need for a cheap, convenient file-transfer capability among diverse systems is pressing, and many efforts similar to ours are under way at many places. We hope that this article may contribute to those efforts; we don't claim to have the last word on any of the issues raised here and expect that this article may uncover some other approaches. We have billed Kermit as a simple protocol; anyone who has read this far will appreciate what must go into the more complicated protocols used in real networks or when integration of microcomputer and mainframe is a major goal—demand paging of remote files, remote database queries, distributed editing, and computation.

Meanwhile, the Kermit protocol has proven successful and continues to grow in popularity. As of this writing, implementations exist for over 50 computer systems; the major ones are listed in table 1. Some have been contributed or enhanced by the institutions listed in the acknowledgments. No single implementation necessarily includes all features mentioned in this article, but all are able to communicate at least at base level. Additional implementations are in preparation, and present ones are being enhanced.

Columbia University is willing to provide all Kermit programs, sources, manuals, and other documentation to computing centers, academic or corporate, in return for a modest fee to cover costs for media, printing, postage, labor, and computing resources. Only magnetic tape and listings can be shipped. We cannot produce floppy disks; instructions are included for bootstrapping the microcomputer implementations from the mainframe computers. Details will be provided on request. Write to

Kermit Distribution
Columbia University Center for Computing Activities
7th Floor, Watson Laboratory
612 West 115th St.
New York, NY 10025

The protocol specification supplemented by examples of existing Kermit implementations allows new implementations to be created with relative ease. In the past, Kermit implementers have shared their work with other Kermit users by contributing it to the Columbia Kermit library. We hope that this practice will continue until Kermit has spread throughout the known world. ■

ACKNOWLEDGMENTS
In designing the initial Kermit protocol, we studied several models, primarily the ANSI recommendation. Others included the Stanford University DIALNET project, the University of Utah "Small FTP" project, and the Stanford University Medical Center TTYFTP project. And we examined some real networks, such as ARPANET and DECnet.

Acknowledgments are also due to the many sites that have contributed new Kermit implementations or enhanced old ones: Stevens Institute of Technology, Digital Equipment Corporation, the National Institutes of Health, Cornell University, the University of Toronto, the University of Tennessee, University of Toledo, Pima Community College, Cerritos College, and others. Thanks to Dr. Howard Eskin for help with this article and to Henson and Associates for permission to use Kermit.

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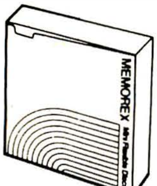
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THIS IS A LIST *of books recently received at* BYTE *Publications. The list is not meant to be exhaustive. its purpose is to acquaint* BYTE *readers with recently published titles in computer science and related fields. We regret that we cannot review or comment on all the books we receive; instead, this list is meant to be a monthly acknowledgment of these books and the publishers who sent them.*

pages, 16.5 by 24 cm, hardcover, ISBN 0-201-11519-0, $15.55.

FIRST COURSE IN DATA PROCESSING WITH BASIC, 2nd ed. J. Daniel Couger and Fred R. McFadden. New York: John Wiley & Sons, 1984; 620 pages, 21.3 by 27.8 cm, softcover, ISBN 0-471-86945-7, $25.95.

FIRST COURSE IN DATA PROCESSING WITH BASIC, COBOL, FORTRAN, AND RPG, 3rd ed. J. Daniel Couger and Fred R. McFadden. New York: John Wiley & Sons, 1984; 702 pages, 21.3 by 27.8 cm, softcover, ISBN 0-471-86946-5, $26.95.

FUNDAMENTALS OF PROGRAMMING LANGUAGES, 2nd ed. Ellis Horowitz. Rockville, MD: Computer Science Press, 1984; 464 pages, 15.5 by 23.5 cm, hardcover, ISBN 0-88175-004-2, $26.95.

GAMES COMPUTERS PLAY, Keith S. Reid-Green. Bedford, MA: Digital Press, 1984; 256 pages, 21.5 by 25.5 cm, softcover, ISBN 0-932376-29-0, $16.

GETTING THE MOST FROM WORDSTAR AND MAILMERGE, M. David Stone. Englewood Cliffs, NJ: 1984; 256 pages, 17.5 by 23.5 cm, softcover, ISBN 0-13-354382-X, $14.95.

GETTING THE MOST FROM YOUR VIC 20, Hank Librach. Englewood Cliffs, NJ: Prentice-Hall, 1983; 144 pages, 15 by 22.8 cm, softcover, ISBN 0-13-354357-9, $9.95.

A GUIDE TO THE BEST BUSINESS SOFTWARE FOR THE IBM PC, Richard C. Dorf. Reading, MA: Addison-Wesley, 1983; 224 pages, 18.5 by 23.5 cm, softcover, ISBN 0-201-10256-0, $12.95.

HOW TO BUY SOFTWARE, Alfred Glossbrenner. New York: St. Martin's Press, 1984; 672 pages, 15.5 by 23.5 cm, softcover, ISBN 0-312-39551-5, $14.95.

HOW TO CREATE YOUR OWN COMPUTER BULLETIN BOARD, Lary L. Myers. Blue Ridge Summit, PA: Tab Books, 1983; 224 pages, 19.5 by 23.5 cm, softcover, ISBN 0-8306-1633-0, $12.50.

HOW TO GET INTIMATE WITH YOUR COMPUTER, Fred D'Ignazio. New York: McGraw-Hill, 1984; 168 pages, 13.5 by 20.3 cm, softcover, ISBN 0-07-016901-2, $6.95.

HOW TO PROGRAM YOUR COMMODORE 64, Carl Shipman. Tucson, AZ: HP Books, 1983; 336 pages, 21.5 by 27.5 cm, softcover, ISBN 0-89586-310-3, $9.95.

THE IBM/PC & BUSINESS SOFTWARE, James E. Kelley Jr. Wayne, PA: Banbury Books, 1983; 254 pages, 17.8 by 23.5 cm, spiral-bound, ISBN 0-88693-000-6, $39.95. Includes two floppy disks.

IBM PC EXPANSION & SOFTWARE GUIDE, 3rd ed. Staff of Que Corp. Indianapolis, IN: Que Corp., 1983; 672 pages, 20.5 by 27.5 cm, softcover, ISBN 0-88022-057-0, $19.95.

THE IBM PC USER'S GUIDE, Michael Bane with Mark Andrews. New York: Macmillan Publishing Co., 1983; 128 pages, 13.5 by 20.8 cm, softcover, ISBN 0-02-008710-1, $5.95.

INTERACTIVE PROGRAMMING ENVIRONMENTS, David R. Barstow, Howard E. Shrobe, and Erik Sandewall. New York: McGraw-Hill, 1984; 224 pages, 15.8 by 23.5 cm, hardcover, ISBN 0-07-003885-6, $34.95.

INTERFACING TEST CIRCUITS WITH SINGLE-BOARD COMPUTERS, Robert H. Luetzow. Blue Ridge Summit, PA: Tab Books, 1983; 256 pages, 19.5 by 23.5 cm, softcover, ISBN 0-8306-0583-5, $13.50.

INTEGRATED-CIRCUIT OPERATIONAL AMPLIFIERS, 2nd ed. George B. Rutkowski. Englewood Cliffs, NJ: Prentice-Hall, 1984; 334 pages, 15.5 by 23.8 cm, hardcover, ISBN 0-13-469007-9, $26.95.

(continued)

BOOKS RECEIVED

INTRODUCING THE IBM PCJR, Andrew M. Seybold. Indianapolis, IN: Howard W. Sams & Co., 1983; 160 pages, 20 by 23.5 cm, softcover, ISBN 0-672-22317-1, $12.95.

INTRODUCTION TO BUSINESS PROGRAMMING & SYSTEMS ANALYSIS, Keith Lohmuller. Blue Ridge Summit, PA: Tab Books, 1983; 240 pages, 13 by 21 cm, softcover, ISBN 0-8306-1437-0, $13.50.

THE IOTA PROGRAMMING SYSTEM, R. Nakajima and T. Yuasa, eds. Lecture Notes in Computer Science #160. New York: Springer-Verlag, 1982: 228 pages, 16.5 by 24 cm, softcover, ISBN 0-387-12693-7, $11.50.

THE JOY OF COMPUTERS, Peter Laurie. Boston, MA: Little, Brown and Company, 1983: 193 pages, 21.5 by 28.5 cm, hardcover, ISBN 0-316-51636-8, $19.95.

A KID'S MANUAL FOR PROGRAMMING THE SINCLAIR/TIMEX COMPUTERS, Ed Hoornaert. Blue Ridge Summit, PA: Tab Books, 1983; 168 pages, 13 by 21 cm, softcover, ISBN 0-8306-0608-4, $7.25.

LEARNING LISP, Gnosis. Englewood Cliffs, NJ: Prentice-Hall, 1984; 208 pages, 17.3 by 23.8 cm, softcover, ISBN 0-13-527839-2, $29.95.

THE MBASIC HANDBOOK, Walter A. Ettlin and Gregory Solberg. Berkeley, CA: Osborne/McGraw-Hill, 1983; 478 pages, 16.3 by 23.3 cm, softcover, ISBN 0-88134-102-9, $17.95.

MICROCHIP TECHNOLOGY, Charles Kerridge. New York: John Wiley & Sons, 1983; 192 pages, 15.3 by 22.8 cm, softcover, ISBN 0-471-90240-3, $16.95.

MICROCOMPUTER PROGRAMMING WITH MICROSOFT BASIC, Robert G. Crawford and David T. Barnard. Reston, VA: Reston Publishing Co., 1984; 432 pages, 17.5 by 23.5 cm, softcover, ISBN 0-8359-4356-9, $15.95.

MICROCOMPUTER SYSTEMS: THE 8086/8088 FAMILY, Yu-cheng Liu and Glenn A. Gibson. Englewood Cliffs, NJ: Prentice-Hall, 1984; 560 pages, 18.5 by 24 cm, ISBN 0-13-580944-4, $32.95.

MICROCOMPUTING IN AGRICULTURE, James Legacy, Tom Stitt, and Fred Reneau. Reston, VA: Reston Publishing Co., 1984; 272 pages, 18 by 24 cm, hardcover, ISBN 0-8359-4353-4, $19.95.

MINICOMPUTERS IN INDUSTRIAL CONTROL, Thomas J. Harrison, ed. Englewood Cliffs, NJ: Prentice-Hall, 1983; 384 pages, 18.5 by 26.3 cm, hardcover; ISBN 0-13-584235-2, $39.95.

NOTES ON INTRODUCTORY COMBINATORICS, George Pólya, Robert E. Tarjan, and Donald R. Woods. Boston, MA: Birkhäuser Boston Inc., 1983; 208 pages, 14.5 by 22.8 cm, softcover, ISBN 0-8176-3170-4, $9.95.

THE OSBORNE/MCGRAW-HILL GUIDE TO YOUR APPLE III, Stanley M. Miastkowski. Berkeley, CA: Osborne/McGraw-Hill, 1983; 288 pages, 16.3 by 23.5 cm, softcover, ISBN 0-88134-101-0, $17.95.

THE OSBORNE/MCGRAW-HILL HOME COMPUTER SOFTWARE GUIDE, Steve Ditlea. Berkeley, CA: Osborne/McGraw-Hill, 1984; 206 pages, 15.8 by 23.3 cm, softcover, ISBN 0-88134-107-X, $11.95.

PROBLEM SOLVING WITH BASIC, Donald D. Spencer. New York: Charles Scribner's Sons, 1984; 160 pages, 13.8 by 20.8 cm, softcover, ISBN 0-684-18036-7, $7.95.

PROGRAMMING IN C, Robert J. Traister. Englewood Cliffs, NJ: Prentice-Hall, 1984; 206 pages, 15.3 by 22.8 cm, softcover, ISBN 0-13-729641-X, $16.95.

PROGRAMS FOR YOUR TIMEX/SINCLAIR 1000, Melbourne House. Englewood Cliffs, NJ: Prentice-Hall, 1983; 112 pages, 14 by 20.3 cm, softcover, ISBN 0-13-729780-7, $5.95.

PROPER BASIC, Brian C. Walsh. New York: John Wiley & Sons, 1983; 416 pages, 15.3 by 23.5 cm, hardcover, ISBN 0-471-90081-8, $27.95.

REAL MANAGERS USE PERSONAL COMPUTERS!, Dick Heiser. Indianapolis, IN: Que Corp., 1983; 224 pages, 18.5 by 23.5 cm, softcover, ISBN 0-88022-031-7, $14.95.

REINVENTING MAN, THE ROBOT BECOMES REALITY, Igor Aleksander and Piers Burnett. New York: Holt, Rinehart and Winston, 1984; 304 pages, 15.5 by 23.5 cm, hardcover, ISBN 0-03-063857-7, $17.95.

SECURITY. IFIP/SEC '83, V. A. Fak, ed. Amsterdam and New York: North-Holland Publishing Co., 1983; 366 pages, 15.5 by 23 cm, hardcover, ISBN 0-444-86669-8, $39.

SOFTWARE SOLUTIONS FOR THE IBM PC, Thomas H. Willmott. Englewood Cliffs, NJ: Prentice-Hall, 1983; 240 pages, 17.5 by 24.3 cm, softcover, ISBN 0-13-822387-4, $14.95.

SPRITE GRAPHICS FOR THE COMMODORE 64, Sally Greenwood Larsen. Englewood Cliffs, NJ: Micro Text/Prentice-Hall, 1983; 192 pages, 15 by 22.8 cm, softcover, ISBN 0-13-838136-4, $15.95.

TELECOMMUNICATIONS IN THE INFORMATION AGE, Loy A. Singleton. Cambridge, MA: Ballinger Publishing Co., 1984; 256 pages, 15.5 by 23.5 cm, hardcover, ISBN 0-88410-428-1, $19.95.

THROUGH THE MICROMAZE, Wayne Creekmore. Culver City, CA: Ashton-Tate, 1984; 64 pages, 21.5 by 25.3 cm, softcover, ISBN 912677-02-3, $9.95.

THE TI 99/4A USER'S GUIDE, Bill Brewer with Mark Andrews. New York: Macmillan Publishing Co., 1983; 128 pages, 13.5 by 20.8 cm, softcover, ISBN 0-02-008720-9, $5.95.

TIMEX SINCLAIR 1000/ZX81 USER'S HANDBOOK, Trevor J. Terrell and Robert J. Simpson. Indianapolis, IN: Howard W. Sams & Co., 1983; 160 pages, 13.5 by 21.5 cm, spiral-bound, ISBN 0-672-22012-1, $5.95.

UNDERSTANDING THE APPLE II, James Fielding Sather. Chatsworth, CA: Quality Software, 1983; 356 pages, 21.5 by 27.5 cm, softcover, ISBN 0-912985-01-1, $22.95.

UNDERSTANDING COMPUTERS, Donald D. Spencer. New York: Charles Scribner's Sons, 1984; 400 pages, 15.3 by 22.8 cm, softcover, ISBN 0-684-18038-3, $13.95.

UNDERSTANDING UNIX, James R. Groff and Paul N. Weinberg. Indianapolis, IN: Que Corp., 1983; 256 pages, 18.3 by 23.3 cm, softcover, ISBN 0-88022-064-3, $17.95.

UNLEASH YOUR POCKET COMPUTER, David P. Sumner. Reston, VA: Reston Publishing Co., 1984; 176 pages, 15.3 by 22.8 cm, softcover, ISBN 0-8359-8072-3, $14.95.

USING dBASE II, Carl Townsend. Berkeley, CA: Osborne/McGraw-Hill, 1984; 240 pages, 18.5 by 23.3 cm, softcover, ISBN 0-88134-108-8, $18.95.

USING & PROGRAMMING THE ZX81/TS1000, Albert N. Sickler. Blue Ridge Summit, PA: Tab Books, 1983; 176 pages, 13 by 21 cm, softcover, ISBN 0-8306-0617-3, $8.25.

VIC 20 EXPOSED, John Vander Reyden. Nashville, TN: Melbourne House Software Inc., 1983; 174 pages, 14 by 20.8 cm, softcover, ISBN 0-86759-123-4, $14.95.

VISICALC FOR APPLE II, II+, IIe, John S. Craver. Tucson, AZ: HP Books, 1983; 224 pages, 21.5 by 28 cm, 3-ring binder, ISBN 0-89586-274-3, $14.95.

WHAT COMPUTERS CAN DO, 2nd ed. Donald D. Spencer. New York: Charles Scribner's Sons, 1984; 368 pages, 15.3 by 22.8 cm, softcover, ISBN 0-684-18037-5, $12.95.

YOUR FIRST VIC 20 PROGRAM, Rodnay Zaks. Berkeley, CA: Sybex, 1983; 208 pages, 17.3 by 27.8 cm, softcover, ISBN 0-89588-129-2, $9.95.

YOUR PERSONAL COMPUTER CAN MAKE YOU RICH IN STOCKS AND COMMODITIES, Curtis M. Arnold. West Palm Beach, FL: Weiss Research Inc., 1984; 320 pages, 17.5 by 24 cm, hardcover, ISBN 09613048-0-4, $34.95. ■

PERIPHERALS

Portable 360K-byte Disk Drive for Briefcase Computers

You no longer have to connect your briefcase computer to a desktop micro whenever you want to dump your files to disk because you can do it with the Percom Portable Disk Drive. A 360K-byte floppy-disk drive, the Portable Disk Drive features hardware by Percom Data Company and software by the Portable Computer Support Group.

This mass-storage device is powered by a 12-volt rechargeable battery pack, and it connects to a briefcase computer's RS-232C printer port with a cable. It weighs 3 pounds and measures 2 by 4¼ by 8¼ inches.

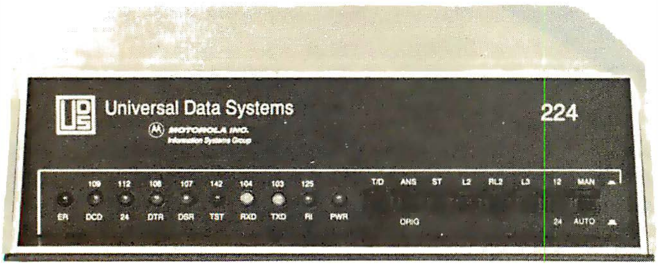
The Percom Interface operating system comes with the drive and resides in an 8K-byte ROM within the drive.

Also provided is Portable DOS, which allows the computer to talk with the drive and provides access to a RAM directory, called RAM Files. From RAM Files you can save any RAM file to disk, delete RAM files, ascertain the size (in bytes) of any RAM file, save files presently in RAM under a single disk filename, and save single files to a previously saved subdirectory.

The Portable Disk Drive sells for $799, including all software, a connecting cable, an AC adapter/battery charger, and manual. An accessory cable is available for applications requiring simultaneous use of a peripheral through the RS-232C port. For further information, contact Portable Computer Support Group, 11035 Harry Hines Blvd. #207, Dallas, TX 75229, (214) 351-0564.

Circle 513 on inquiry card.

Full-Duplex Modem Priced at Less than $1000



The Model 224 full-duplex 2400-bps modem from Universal Data Systems has a suggested retail price of less than $1000. This modem uses the intelligence of a microprocessor to provide you with automatic telephone answering, adaptive equalization, and complete diagnostic capabilities. It operates asynchronously or synchronously over the Public Switched Telephone Network. In its 1200-bps fallback mode, it communicates with any other product that's compatible with AT&T 212 standards.

This modem complies with the international CCITT recommendation for a V.22 *bis* data modem at 2400 bps. When on the receiving end, the Model 224 automatically detects if the calling modem is compatible with AT&T 212 and adapts its speed and modulation scheme accordingly. Miscellaneous features include front-panel LED indicators and switches.

Universal Data Systems, a unit of the Information Systems Group of Motorola Corporation, has set the price of the Model 224 modem at $995. Contact Universal Data Systems, 5000 Bradford Dr., Huntsville, AL 35805, (205) 837-8100.

Circle 511 on inquiry card.

Commodore 64 Memory Expansion

Leader Electronic Technology Company has announced the availability of an adapter that lets you use Leader's 64K-byte memory expander with the Commodore 64. When used with the Commodore 64, the Model 64KV memory expander and the Model 64KVA adapter combine to partition hexadecimal addresses 8000 through 9FFF into eight separate blocks of 8K-byte locations. Each block is selected by a single POKE instruction. The RAM module plugs directly into the Commodore 64's expansion port.

The Model 64KVA adapter has a suggested list price of $29.95. The Model 64KV memory module, which can work with the VIC-20, sells for $109.95. A complete package for the Commodore 64 is available for $139.95. Full documentation is provided. A memory expander that will provide the Commodore 64 with up to 256K bytes of memory is in development. At press time, the manufacturer anticipates pricing to be in the range of $140 per 64K-byte module. For details, contact Leader Electronic Technology Co., 7310 Wells Rd., Plain City, OH 43064, (614) 873-4410.

Circle 516 on inquiry card.

Low-Cost Dot-Matrix Printer

The $259 Fastext-80 dot-matrix impact printer from Smith-Corona runs at 80 cps and produces an 80-character line at 10 cpi (characters per inch). It features emphasized or elongated impressions, bit-mapped graphics, and true descenders. It has a full-line buffer and a 96-character ASCII set. The Fastext-80 has six pitches: pica-sized at 10 cpi, elite-sized at 12 cpi, condensed at 16.7 cpi, and enlarged print at 5, 6, or 8.3 cpi. Standard and elongated character matrices are 9 by 8 and 10 by 8 dots, respectively. Horizontal resolution is 60 or 72 dots per inch; vertical is 72 dots per inch.

Fastext-80 uses drop-in ribbon cassettes, which are said to yield 1 million characters before replacement. Among its diverse features are bidirectional printing, Centronics parallel-interface compatibility, friction feed, and a self-test switch.

Available accessories include a removable tractor feed that accepts forms ranging from 3 to 10½ inches wide, a user-installable RS-232C serial interface, and a roll-paper holder. Contact Smith-Corona, 65 Locust Ave., New Canaan, CT 06840, (203) 972-1471.

Circle 512 on inquiry card.

Remote On/Off for PC XT

Tel-A-Switch lets you switch on or off an IBM PC XT over telephone lines. This solid-state, self-contained unit uses the signal generated by Hayes Microcomputer Products' Smartmodem to perform this service. Tel-A-Switch can provide up to 1200 watts of electricity, which is equivalent to the power consumed by three IBM PC XTs.

A lock-on feature is provided. Once the computer is powered up and operating, this mode prevents power loss due to interruptions that can occur on telephone lines. Tel-A-Switch can be used without a telephone connection to automatically turn off the PC XT after a task has been executed in the batch mode.

A remote software package is available for Tel-A-Switch that supports up to 20 different terminals. The remote software requires a minimum of 64K bytes, one disk drive, and PC-DOS.

Tel-A-Switch alone is priced at $175. With the remote software package, the suggested price is $287.50. Contact Texas Technology Co., POB 740694, Dallas, TX 75374, (214) 783-9218.

Circle 515 on inquiry card.

NEW SYSTEMS

Three Single-Board Computers Use iAPX 86/186

Three recently introduced single-board computers from Intel use the company's iAPX 186 or iAPX 86 microprocessors. The computers, the iSBC 186/03, iSBC 186/78, and iSBC 86/35, measure 6¾ by 12 inches and provide a central processor, operating-system functions, peripheral and device interfaces, memory, and industry-standard software. They are based on Intel's 16-bit 8086 and 80186 microprocessors and operate under the iRMX 86 operating system. The iSBC 186/03 costs $1650, and the iSBC 86/35 is $3495. Engineering samples of the iSBC 186/78 are $3000.

The iSBC 186/03 comes with the 6-MHz 80186, eight 28-pin universal memory sites (expandable to twelve), the 80130 iRMX 86 nucleus operating-system component, two iSBX I/O expansion connectors, an iLBX interface for high-speed memory expansion, two serial I/O channels, and a parallel port.

The iSBC 186/78 is a graphics subsystem built on the 80186. In addition to the memory sites and iSBX connectors, it includes Intel's 82720 bit-mapped graphics controller, a dedicated 512- by 512- by 4-byte RAM display buffer, and a color lookup table that allows 16 simultaneous colors to be displayed from a palette of 4096. In addition, graphics-software interpreters supporting the NAPLPS standard or the proposed ANSI virtual device interface are offered.

Built around the 8086 microprocessor with a 5- or 8-MHz clock rate, the iSBC 86/35 contains 512K bytes of dual-ported RAM (expandable to 1 megabyte), four 28-pin JEDEC sockets for increased memory, and an optional iAPX 8087 numeric coprocessor.

Contact Intel Corp., Literature Dept. C-21, 3065 Bowers Ave., Santa Clara, CA 95051.

Circle 520 on inquiry card.

16-Bit IBM-Compatible Computer Kit



The 16-bit HS-151 Desktop Personal Computer from Heathkit is software- and hardware-compatible with the IBM PC. Offered in kit or preassembled versions, the HS-151 comes with 128K bytes of RAM, two RS-232C serial ports, a Centronics-type parallel interface, RGB color output, eight-level gray-scale monochrome output, four IBM PC-compatible expansion slots, and a detached keyboard. Mass storage is provided by one or two 5¼-inch IBM-format floppy-disk drives, each with a 360K-byte capacity.

The HS-151 uses Intel's 8088 microprocessor and MS-DOS. Its expansion bus is electrically and physically compatible with most off-the-shelf accessory boards for the IBM. The HS-151's keyboard is a redesigned IBM-compatible device, offering an enlarged L-shaped Return key and a double-wide Shift key. Three testing procedures help you check out the HS-151's operating condition.

A preassembled version of the HS-151 with a built-in 10.6-megabyte Winchester hard-disk drive will be available soon. The single-drive kit is $1899, while the dual-drive kit is $2199. Contact Heath Co., Dept. 349-175, Benton Harbor, MI 49022. In Canada, contact Heath Co., Dept. 3100, 1020 Islington Ave., Toronto, Ontario M8Z 5Z3.

Circle 518 on inquiry card.

MPF-III Compatible with IIe Software

The MPF-III microcomputer from Multitech International is distributed in North America by Cyber Videocom of Vancouver, Canada. Designed to be software-compatible with the Apple IIe, the MPF-III can run such programs as Apple Pascal, Logo, WordStar, dBASE II, and Multiplan. It employs the 6502 microprocessor and offers you 64K bytes of RAM and 24K bytes of ROM.

Standard are 80-column text displays, uppercase and lowercase characters, high-resolution graphics with 6 colors, and low-resolution graphics with 16 colors. Monitor and NTSC television connectors and a sound generator are supplied. The MPF-III has interfaces for joysticks, data cassettes, floppy-disk drives, and a printer with Epson and C. Itoh drivers.

The MPF-III has a 90-key detached keyboard with numeric pad and function keys, including one-key BASIC- and DOS-command entry. For full-screen editing, dedicated keys for character delete, insert, replace, and copy are provided.

The base price is $995. Contact Cyber Videocom Inc., POB 35401, Station E, Vancouver, British Columbia V6M 4G5, Canada, (604) 875-1517.

Circle 519 on inquiry card.

Computer Offers Low-Cost Office Networking

QSA, a San Diego–based computer manufacturer, offers its Q/Net multiuser, multiprocessor microcomputer as a low-cost alternative to office networking. The company claims that a five-user network system would cost $11,220 including terminals.

Q/Net nodes and resources can be connected in any configuration ranging from 1 to 254 users with 1 to 8 file servers on the network. System expansion is merely a matter of adding another node to the network. Additional hard disks can be added to multiple file servers, and other peripherals can be supported through Q/Net's SASI interface.

The network operating system is TurboDOS, a CP/M-compatible DOS that provides a pathway for CP/M-86 and MS-DOS. Other software features include interprocessing communications, interfaces to IBM communications protocols (including 3270 and X.25), print spooling, and shared databases.

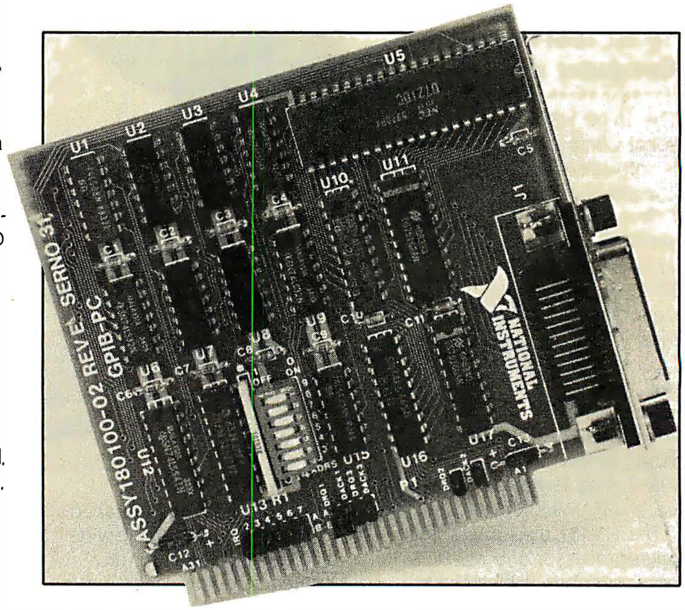
For details on possible configuration schemes, contact QSA, 7170 Convoy Court, San Diego, CA 92111, (619) 292-1891.

Circle 521 on inquiry card.

(continued)

ADD-INS

Bus Interface for PC



The National Instruments GPIB-PC interface card uses the NEC 7210 GPIB controller chip and a programmable-array logic to provide a complete set of GPIB functions with a minimum of circuit elements and only eight I/O (input/output) addresses. Transfer of large data files between the GPIB and the IBM PC's memory is accomplished by a DMA controller at speeds of 300 bytes per second. Subroutines are callable from applications programs in BASIC, 8088 assembly language, Pascal, FORTRAN, SuperSoft FORTRAN, and C. GPIB-PC conforms in height, width, and I/O channel slot dimensions for use with the IBM PC or PC XT. It will work with standard GPIB cables.

A handler, high-level and primitive functions, a configuration program, diagnostic programs, and an interactive control program make up the GPIB-PC's software. The handler program controls the GPIB-PC hardware interface and is designed as a loadable device handler rather than as a driver. The operating system manages the GPIB as one of its system resources. The handler can control more than one GPIB-PC simultaneously, which lets you place a variety of devices on separate GPIB's to meet special needs.

The GPIB-PC interface card is $385. The software handler is $75. Optional programming languages are $50, and connecting cables range from $60 to $70, depending on length. Contact National Instruments, 12109 Technology Blvd., Austin, TX 78727, (800) 531-5066; in Texas, (512) 250-9119.

Circle 527 on inquiry card.

Multifunction GPIB for IBM Controls Instruments

Ziatech's ZT 1444 IEEE-488 GPIB (General-Purpose Interface Bus) Controller lets engineers and scientists control measurement, instrumentation, and test equipment with their IBM PCs. The ZT 1444 is a short-slot card offering fast data throughput and software drivers callable from assembly language, BASIC, C, Compiled BASIC, FORTRAN, and Pascal. All the drivers feature a time-out ability, which ensures that the system does not hang up if a device fails to respond. The BASIC package includes an interactive verification program that allows you to exercise the GPIB without having to write code.

The ZT 1444 uses Texas Instruments' TMS9914A GPIB controller chip. It transfers data to or from devices at rates approaching 450K bytes per second using direct memory access. Pass control, which permits more than one computer to control the same devices without recabling, is supported.

Its cable-connector backplate is a plated-steel bracket that effectively controls electromagnetic interference emissions from the IBM. It incorporates a machined GPIB connector housing capable of accepting standard stacking GPIB connectors with no loss of seating reliability.

The ZT 1444 costs $375. The software drivers range from $45 to $55. Contact Ziatech Corp., 3433 Roberto Court, San Luis Obispo, CA 93401, (805) 541-0488.

Circle 523 on inquiry card.

Modem Card for PC Uses CMOS Chips

The POPCOM Model C100 from Prentice Corporation is a 1200-bps auto-dial modem card for the IBM PC, PC XT, PC Portable, and IBM-slot-compatible computers. The C100 uses a pair of CMOS (complementary metal-oxide semiconductors) ICs to achieve full-duplex AT&T 212-compatible operation, tone sensing, and voice/data control. This 12.4- by 4.2- by 0.575-inch card uses only one IBM PC expansion slot and lists for a suggested price of $445.

Among its technical specifications are full call-progress tone sensing of dial and busy tones, remote ring, and voice. This is implemented by a 20-pole filter, which has a patent-pending switching technique. The card is said to be the first one to be able to sense when the local telephone handset is lifted. With this capability, the C100 can switch between voice and data operations, even during the same telephone call. This function eliminates the need for dedicated telephone lines for data.

Production deliveries of the POPCOM C100 began last month. Contact Prentice Corp., 266 Caspian Dr., POB 3544, Sunnyvale, CA 94088-3544, (408) 734-9810.

Circle 522 on inquiry card.

Hard-Disk Bootloader for IBM PC

A plug-in chip offering hard-disk boot capability for third-party hard-disk drives for the IBM PC, FiXT is manufactured by Golden Bow Systems. FiXT creates a complete BIOS interface between the IBM PC and the hard disk similar to that provided by the IBM PC XT. It allows the operating system to be bootloaded directly from the fixed disk and permits fixed-disk operations to be performed directly by the operating system.

FiXT plugs into the unused ROM socket of the IBM Personal Computer. It's a complete replacement for installable device drivers. This chip allows standard PC-DOS disk partitioning and formatting facilities for multiple operating systems.

FiXT is currently available for Datamac, Davong, Pegasus by Great Lakes, Percom, and Zobex hard-disk drives. The suggested retail price is $70. Contact Golden Bow Systems, POB 3039, San Diego, CA 92103, (619) 298-9349.

Circle 525 on inquiry card.

SOFTWARE • APPLE II

Mini-Database for Apples

Facts Files 2 is a low-cost mini-database program for the Apple II family from D:Ness Software Company. This $24.95 program gives you an unlimited number of files, password protection, on-disk instructions, and the ability to design your own record forms. It has an edit feature that lets you quickly update records, and with its sort feature you can organize your records by any field.

Facts Files 2 accommodates up to 400 records in any file and up to 10 different files per floppy disk. Each file's record outline can contain from 2 to 13 fields of data.

Minimum system requirements are 64K bytes of memory and one disk drive. When ordering from the manufacturer, add $1 for shipping and handling. Contact D:Ness Software Co., POB 5671, Fort Smith, AR 72913.
Circle **535** on inquiry card.

DB Master 4 Plus Is Designed for Apples

Stoneware's DB Master 4 Plus information-management system for Apple II series computers has a global editor and a special label printer. Other programming options let you combine data from two or more files with the same format, change the file format without retyping information, recover data from damaged disks, and transfer data between DB Master files and DIF text files.

DM Master 4 Plus comes with a file-converter program that can convert VisiFile and pfs: files to DB Master files. A user's guide, which contains a tutorial and a reference guide, is supplied.

DM Master 4 Plus requires 64K bytes of RAM. The retail price is $350. Contact Stoneware Inc., 50 Belvedere St., San Rafael, CA 94901, (415) 454-6500.
Circle **536** on inquiry card.

Double-Res Package ProDOS-Compatible

ALF Products' HGR6 Double-Res Graphics Package for the Apple IIe is compatible with ProDOS. This program adds a variety of new functions directly to Applesoft; e.g., statements HGR3 through HGR6 work like the familiar HGR and HGR2 statements, but with 16 high-resolution colors and a 560- by 192-dot resolution.

HGR6 gives you the ability to modify existing Applesoft programs so that they can use the additional colors and higher resolution. You can save your double-resolution images to both DOS 3.3 and ProDOS disks.

HGR6 is provided with both a DOS 3.3 disk and a ProDOS disk. It requires an extended 80-column card. Owners of the older version of this program can return it to ALF Products for a free replacement. The list price is $49.95. Contact ALF Products Inc., 1315-F Nelson St., Denver, CO 80215, (303) 234-0871.
Circle **532** on inquiry card.

Word Processor Features Typing Tutor

The Write Choice for the Apple II computers, including the IIc, combines a full-feature word processor with a typing tutorial. The typing lessons come with a high-resolution game and a keyboard tutorial. Twenty-three lessons are dedicated to teaching the Dvorak keyboard, and 24 lessons cover the QWERTY keyboard.

The Write Choice comes with documentation that shows you how to correct grammar and properly format written documents. It also covers punctuation rules and offers tips on composition. The retail price is $44.95. Contact Roger Wagner Publishing Inc., Suite E, 10761 Woodside Ave., Santee, CA 92071, (619) 562-3221.
Circle **533** on inquiry card.

SOFTWARE • APPLE MACINTOSH

Data Manager Uses Mac's Features

The Main Street Filer information-management program takes advantage of the Macintosh's technology by using pull-down menus, dialogue boxes, and mouse commands. All file designs, record retrievals, and reporting functions can be handled with the Mac's mouse.

Main Street Filer's filing system and report generator can handle up to 65,000 records in each user-designed file, with up to 36 fields of 40 characters in each record.

This program uses a B+ Tree index system, which eliminates time-consuming sorting operations. Four indexes for each file can be maintained. Supplied print programs let you prepare customized reports, mail-list reports and labels, envelopes, and Rolodex cards.

The suggested retail price for Main Street Filer is $249.95. Contact Main Street Software, Suite 304, One Harbor Dr., Sausalito, CA 94965, (800) 824-8757; in California, (415) 332-1274.
Circle **537** on inquiry card.

CAD Program for Civil Engineering

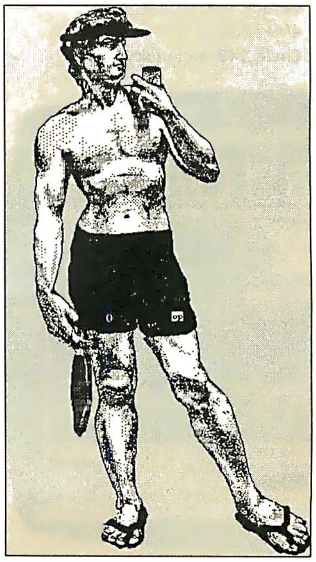
PC CAD, a computer-aided design program for civil engineering and oil and gas mapping, operates on the Macintosh and requires a Hewlett-Packard plotter. It draws subdivision, contour, plan and profile, and surveying maps.

A complete set of coordinate geometry routines for three-dimensional computation is supplied with PC CAD. Among the point routines are resection, merge and plot, decimal formats, and assign/reassign. Its intersection routines give you such functions as offset, right-angle, and right-of-way.

The plotting package for HP 7400/7500 series plotters creates automatic tables, contouring, and sheet sizing. User-definable and user-selectable options are supplied.

PC CAD is also available for the IBM PC. The suggested list price is $1450. Contact Houseman & Associates, Allied Cypress Bank Building, POB 474, Cypress, TX 77429, (713) 890-5160.
Circle **541** on inquiry card.

ClickArt for MacPaint and MacWrite



ClickArt gives you more than 100 professionally drawn images that can be used with MacPaint or MacWrite to create invitations, charts, and slides, or for adding a snappy punch to a report. Images include arrows, stars, borders, wine glasses and bottles, city skylines, cartoons, and full-page pictures of classic cars, Albert Einstein, and Boy George.

ClickArt illustrations can be modified in any way you choose or surrounded with text. The program is priced at $49.95. Contact T/Maker Co., 2115 Landings Dr., Mountain View, CA 94043, (415) 962-0195.
Circle **538** on inquiry card.

Figure 1: *Michelangelo's* David *at the beach.*

(continued)

SOFTWARE • IBM PC

InfoStar+, Powerful DBMS

MicroPro has announced the availability of version 1.6 of InfoStar+, a database-management system. InfoStar+ has a built-in model for transaction processing, a data-dictionary utility, and the ability to automatically restructure an existing database.

The transaction-processing model prompts you into identifying the files to be updated and the data within each file to be used. You can access 16 files simultaneously. After receiving your responses, InfoStar+ automatically records current transactions and updates the master file while letting you access additional information derived from the process. Reports can be produced.

The data-dictionary utility lists all fields in the database and their characteristics. A database restructure feature lets you add, delete, and change the order of fields in an existing database without reentering data.

InfoStar+ has the ability to customize data-entry requirements down to the character level, and its sorting routine is said to be high speed. It allows up to 255 fields per record, 64,000 records per file, and 255 characters per field, sorting on 32 files, and 9 control breaks.

Additional features include cursor-drawn data-entry forms, a fill-in-the-blank data-entry procedure, a 60-second quick-report feature, and a built-in tutorial. For comprehensive tasks, InfoStar+ supplies menus that guide you through its full custom-report option.

StarBurst, MicroPro's systems integrator, is included in the InfoStar+ package. StarBurst lets you create customized, menu-driven systems that make automating routine tasks a matter of a single keystroke. Its interface lets you unite MicroPro and non-MicroPro packages, such as WordStar or Lotus 1-2-3, into InfoStar+.

A minimum of 96K bytes of processor memory is required. InfoStar+ will operate with two 320K-byte floppy-disk drives, but a hard-disk drive is recommended. Available in PC-DOS format, it lists for $595, with documentation. Updates to early versions can be obtained through MicroPro's Customer Update department. Update prices are $100 for InfoStar+ 1.0 to 1.6; $150 for InfoStar 1.0 to 1.6; and $300 for StarBurst to InfoStar+ 1.6. MS-DOS formats for the Tandy 2000, TI Professional, and other computers will be offered later this summer. Contact MicroPro International Corp., 33 San Pablo Ave., San Rafael, CA 94903, (415) 499-1200.

Circle **542** on inquiry card.



Word III Suitable for Complex Tasks

The Samna Word III word processor is suitable for complex word-processing tasks, such as lengthy proposals and contracts. It provides automatic indexing, section numbering, glossaries, a column mode, and five-function mathematics. It's currently available for the IBM PC, PC XT, and such IBM PC compatibles as the Compaq, Columbia, Colby, and Corona. The list price is $650.

Word III's automatic indexing feature eliminates the need to manually locate words to be indexed. You merely enter a list of words to be indexed and Word III will locate each occurrence. In the column mode, you can move, copy, insert, and delete columns. The glossary mode enables you to store or retrieve paragraphs and other materials with a single keystroke during document assembly. The five-function mathematics feature eliminates the need to call in a separate program or module to perform simple calculations.

Other capabilities include user-defined function keys, spelling-error detection and correction, and file support for tree-structured directories and subdirectories under MS-DOS 2.0. Tables of contents with section titles and descriptive information can be easily created.

Word III also provides line drawing, hyphenation, justification, pagination, mail-merge, and multilevel Help messages. Alternate keyboard support, including French, German, Spanish, Canadian bilingual, and Greek/mathematics, facilitates special-purpose applications.

Current users of Samna Word II can upgrade to Word III for $250. For further details, contact Samna Corp., Suite C-1200, 2700 Northeast Expressway, Atlanta, GA 30345, (404) 321-5006.

Circle **543** on inquiry card.

NAPLPS Videotex Creation Software

A NAPLPS videotex-creation system that runs on the IBM PC and selected compatibles is available from ESC Information Services Ltd. PCS-UVIC lets you wield 16 colors simultaneously. Colors are selected from a palette of 4096. Using its three standard or four user-defined texture masks, you can create additional color effects. You can also adjust the color bar and backdrop to produce basic screen animation.

PCS-UVIC has keyboard, tablet, and mouse interfaces. Transfers among these user interfaces are unrestricted.

An attributed text mode lets you choose fonts, rotate letters, change line direction, define character size, letter-space words, and set line spacing. You can delete anything you've typed by backspacing. Another feature is a user-definable keyboard, which provides single-keystroke commands.

PCS-UVIC is $500. Contact ESC Information Services Ltd., 381 Irving Rd., Victoria, British Columbia V8S 4A3, Canada, (604) 598-0395.

Circle **546** on inquiry card.

Programming Editor Emulates IBM ISPF

A high-speed programmer's editor by Phaser Systems, SPF/editor emulates the IBM mainframe ISPF editor. It offers full-screen panels that help speed applications editing and full DOS 2.0 path support, which allows you to edit files in any directory as well as execute from any path directory.

Both EBCDIC and ASCII hexadecimal commands are provided with SPF/editor.

The introductory price for SPF/editor is $100. For more information, contact Phaser Systems Inc., 24 California St., San Francisco, CA 94111, (415) 434-3990.

Circle **547** on inquiry card.

SOFTWARE • IBM PCjr

Accounting Application Uses One Drive

PCWare gives a small business complete accounting and invoicing functions for processing as many as 250 customers yielding 300 invoices a month, yet it requires only one IBM PCjr disk drive. This package contains full accounts-receivable, accounts-payable, general-ledger, and invoicing applications.

PCWare will handle 150 suppliers generating up to 400 checks a month and up to 200 general-ledger accounts with as many as 500 monthly postings. In addition, its detailed invoice function accommodates all current taxation rules.

PCWare costs $795. Contact Private Label Software Ltd., 93 Queen St. S, Mississauga, Ontario L5M 1K7, Canada, (416) 826-5510; in Canada, (800) 387-8202.

Circle 548 on inquiry card.

Jr Can Paint Color Graphics

Graph Power Jr from Monument Computer Service lets you draw and paint business-quality graphics on your 128K-byte IBM PCjr. Figures can be drawn and painted with any of IBM's standard palette colors; palettes are modifiable under user control. You can draw images and use various graphics-screen pages for animation. A number of predrawn shapes are included.

You can dump Graph Power Jr images to an IBM Graphics Printer and other dot-matrix or daisy-wheel printers. This package will also work on the IBM PC and PC XT. A single floppy-disk drive and a color monitor are required. The list price is $90. Contact Monument Computer Service, Village Data Center, POB 603, Joshua Tree, CA 92252, (619) 365-6668.

Circle 549 on inquiry card.

Practical Pascal Runs on PCjr

Practical Pascal is available for the IBM PCjr. This complete programming kit consists of the p-System operating system, a UCSD Pascal compiler, a full-screen editor, a file handler, turtle graphics, extended memory capability, RAM disk, and a print utility for formatting letters and labels.

Its documentation is geared toward individuals new to Pascal and includes an implementation guide and the book *UCSD Pascal: A Considerate Approach*, by David Price.

A variety of optional software to expand the capabilities of the system can be obtained. Practical Pascal is priced at $295. Contact Network Consulting Inc., Suite 110, Discovery Park, 3700 Gilmore Way, Burnaby, British Columbia V5G 4M1, Canada, (604) 430-3466 (sales) or (604) 430-6448 (administration/technical).

Circle 552 on inquiry card.

Color-Coded Commands Ease Word Processing



WordPlus-Jr from Professional Software uses a color-coded command system that helps make word processing on the IBM PCjr a breeze. More than 100 features are contained in this program, including on-screen display of the final output, text and column moves, built-in mail-merge facility, horizontal scrolling, three-line headers and footers, automatic pagination, a numeric mode, global search and replace, free-floating cursor movement, and six levels of on-screen help.

WordPlus-Jr will create lists of variable information, print personalized letters, and merge data into a document using user-defined templates for preprinted forms. It can read print files generated by many popular spreadsheet programs as well as records from most mailing-list and database programs. Simultaneous foreground and background operations with full disk access are also supported.

A complete end-user tutorial and reference/learning guide are supplied with WordPlus-Jr. Customer support is available by means of a toll-free telephone number. The suggested retail price for WordPlus-Jr is $149.95. Contact Professional Software Inc., 51 Fremont St., Needham, MA 02194, (617) 444-5224.

Circle 550 on inquiry card.

SOFTWARE • TANDY / RADIO SHACK

Statistical Package and Data Manager

STATS, a statistical package and data-management system for the Radio Shack TRS-80, runs under DOSPlus. It supplies you with a data-management system with general transformation and subset selection, high-quality graphic outputs, step-wise regression analysis, normality and outlier tests, and an ASCII text editor for data entry. All of STATS's routines are in machine language, but to handle large data sets, it stores data on disk in binary code.

The ASCII text editor is fully compatible with Microsoft's FORTRAN and BASIC compilers. You can incorporate your own FORTRAN or BASIC module into STATS. With the supplied FORTRAN interface, you can tailor the software to your needs.

The graphics-output print driver keeps your Epson or Gemini printer operating continuously; the software selects the appropriate format for data listings, plot scales, and analysis. All intermediate results are saved in ASCII files. The final output can be polished either with a program or with a text editor.

STATS is priced at $99.95. When ordering, specify the model numbers of your computer and printer. Contact Summers Statistical Software, 121 South 1225 E, Bountiful, UT 84010.

Circle 554 on inquiry card.

(continued)

PUBLICATIONS

Directory Lists Interface Cables

SPAG, Standard Products Applications Guide, is a comprehensive directory of interface cables for more than 4600 current computer applications. This hard-bound, three-ring book offered by Milford Null Modem lists all major microcomputers alphabetically by manufacturer and model number, sublists potential peripheral applications, and indicates the specific cable required for the interface.

Subscribers to *SPAG* receive updates all year. A hot-line for technical assistance is supported. Subscriptions are $50. Contact Milford Null Modem, Phoenixville Pike and Charlestown Rd., Malvern, PA 19355, (215) 296-8467.

Circle **555** on inquiry card.

Health Software Described in Catalog

A catalog describing physical and mental health programs is available from CTRL Health Software. The catalog contains diet/nutrition, exercise/aerobics, self-improvement, health education, psychology, and game packages for Apple, Atari, Commodore, IBM PC, and Radio Shack TRS-80 computers. The price for each program is listed, and all the programs are available by mail order. Contact CTRL Health Software, 18653 Ventura Blvd. #348, Tarzana, CA 91356, (818) 788-0888.

Circle **558** on inquiry card.

Computer-Science Publications Brochure

New Publications in Computer Science, Technology and Applications 1983 from North-Holland has details on 59 books and 2 new journals covering computer science, technology, and applications. Titles cover a wide range of subjects, including software technology, data communications, graphics, system design, automated manufacturing, robotics, and electronics.

This 128-page brochure is free of charge. Contact North-Holland, Elsevier Science Publishing Co. Inc., POB 1663, Grand Central Station, New York, NY 10163. In Europe, contact North-Holland, POB 1991, 1000 BZ Amsterdam, The Netherlands, Attn: Mr. J. Dirkmaat.

Circle **559** on inquiry card.

Tool and Instrument Catalog

Contact East's free 1984 *Electronic Tool and Test Instrument Catalog* features more than 5000 technical products for assembling, testing, and repairing electronic equipment. Products covered include precision hand tools, test instruments, tool kits, soldering supplies, and static-control products. Photographs, detailed descriptions, and pricing information support each product. Write or call Contact East Inc., 7 Cypress Dr., POB 160, Burlington, MA 01803, (617) 272-5051.

Circle **561** on inquiry card.

Directory Lists RCA Replacements for Industry Devices

A *Cross-Reference Directory* from RCA Solid State outlines RCA replacements for more than 5500 integrated circuits and power devices. Parts are arranged alphabetically, which provides a quick reference to industry types that correspond to RCA devices. Types of devices included are linear integrated circuits, CMOS logic integrated circuits, CMOS microprocessors, power transistors, CMOS memories, power MOSFETs, CMOS peripherals, SCRs, triacs, and ultra-fast recovery rectifiers.

This 36-page publication is free. Request catalog CRG-100B. Contact RCA Solid State Division, Route 202, Somerville, NJ 08876, (800) 526-2177.

Solid-State Processing and Production Guide

The '84 *Solid State Processing & Production Worldwide Buyer's Guide & Directory* is a sourcebook of materials, equipment, and industry services used by manufacturers of solid-state-related products, devices, and circuits. This 460-page softcover book lists more than 2000 companies and 20,000 products. More than 2200 product/services categories and over 3500 cross-references are included. The guide is divided into 60 major categories.

The '84 *Solid State Processing & Production Buyer's Guide* is $50. Contact Technical Publishing, 875 Third Ave., New York, NY 10022, (212) 605-9400.

Circle **556** on inquiry card.

International Video- and Optical-Disk Journal

Memoires Optiques is an English-language, European-based journal devoted to the videodisc and digital optical disk industry. Translated from French each month, *Memoires Optiques* covers international news, developments, and current applications relating to videodisc and digital optical disk technologies. Each issue is illustrated with drawings and photographs.

Single issues of *Memoires Optiques* cost 150 French francs. Air-mail delivery subscriptions are 1500 francs. For more information, contact Memoires Optiques, ARCA Editions, 97, rue Mme Molé, 5600 Vannes, France.

Circle **560** on inquiry card.

Data Sheet Details Compliant Pin

A data sheet describing Interconics Compliant Pin is available. The Compliant Pin is designed for use in printed wiring backplanes and other printed-circuit boards requiring replaceable pins with provisions for wire wrap and adaptability to a two-piece daughter-card connector. It's suitable for applications using sophisticated multilayer backplanes that cannot tolerate damage to the plated through holes. The data sheet describes the pin, its applications, performance, and availability. Photographs and diagrams of the pin in use are provided. Contact Interconics, 610 Bremer Tower, Saint Paul, MN 55101, (612) 228-6590.

Circle **562** on inquiry card.

DEC-Compatible Products Listed

Monosson's DEC-Compatible Product Directory* lists products and services for the DEC market. It includes hardware, software, third-party maintenance, and publications. Lists of equipment-leasing concerns and vendors are supplied. This directory is published quarterly. Single copies are $25. Contact Monosson's DEC*-Compatible Product Directory, POB 71, Kenmore Station, Boston, MA 02215.

Circle **557** on inquiry card.

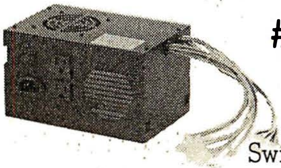
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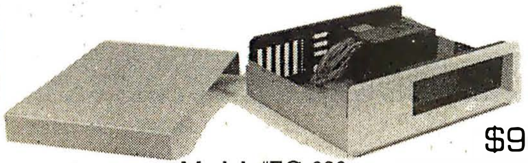
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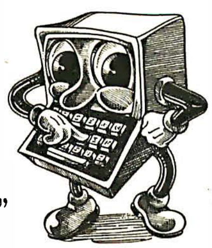
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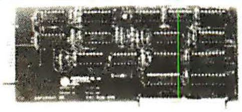
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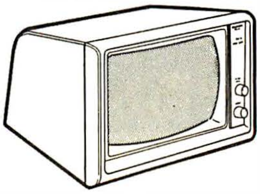
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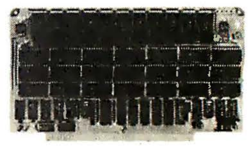
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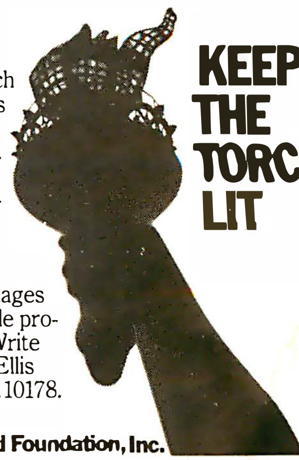
All of the money must come from private donations; the federal government is not raising the funds. This is consistent with the Statue's origins. The French people paid for its creation themselves. And America's businesses spearheaded the public contributions that were needed for its construction and for the pedestal.

The torch of liberty is everyone's to cherish. Could we hold up our heads as Americans if we allowed the time to come when she can no longer hold up hers?

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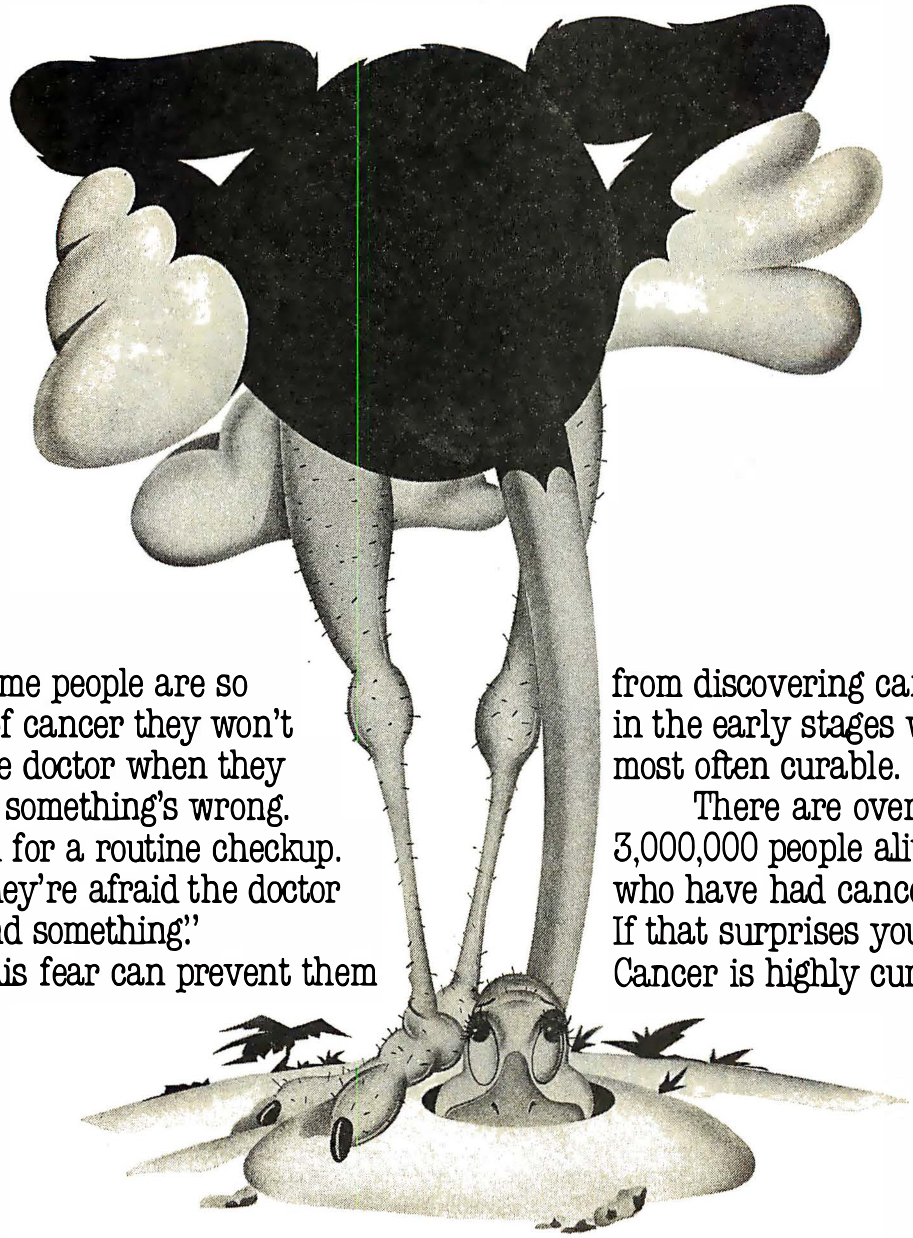
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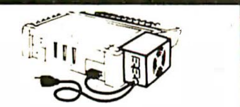
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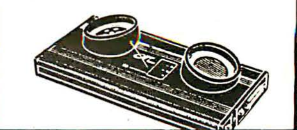
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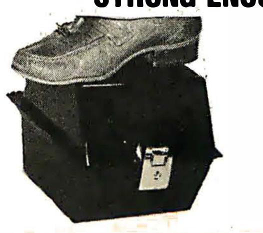
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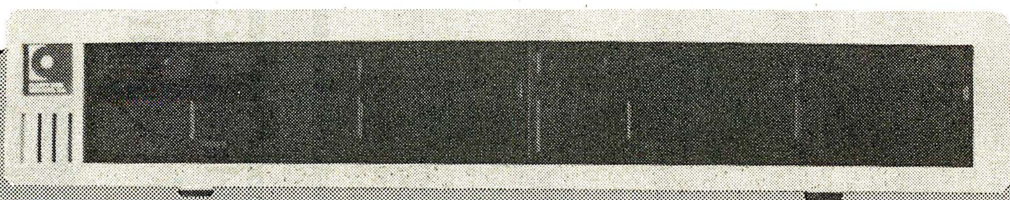
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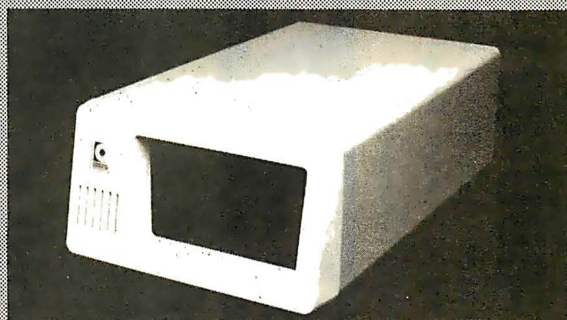
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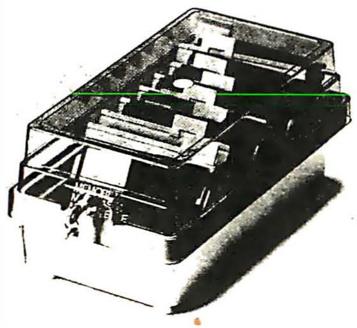
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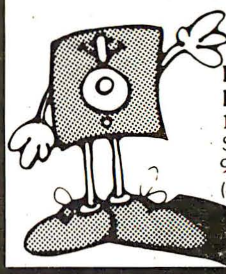
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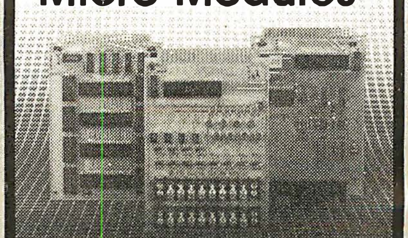
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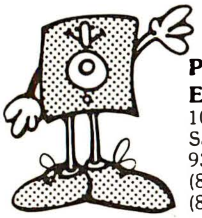
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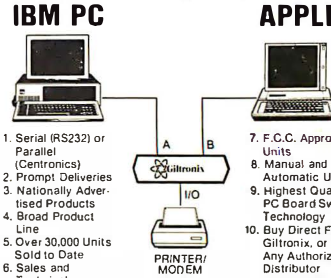
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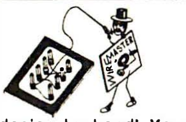
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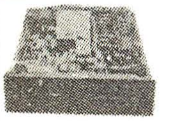
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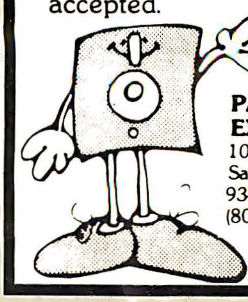
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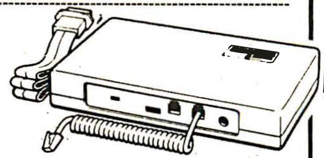
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QUAD 512 PLUS 64K	$325	$219.95
QUAD 512 PLUS 256K	$550	$389.95
QUAD 512 PLUS 512K	$895	$549.95
QUAD COLOR I	$295	$209.95
QUAD COLOR II	$275	$199.95
AST MONOGRAPH+	$595	$449.95
QUAD VIEW	$345	$259.95

PLACE ORDERS TOLL FREE

Continental USA **(800) 421-5500**

Inside California **(800) 262-1710**

Los Angeles Area **(213) 973-7707**

We accept cash, checks, credit cards, or purchase orders from qualified firms and institutions. **Minimum prepaid order $15.00** California residents add 6½% tax. Export customers outside the US or Canada please add 10% to all prices. **Prices and availibility subject to change without notice.** Shipping and handling charges via UPS Ground 50¢/lb. UPS Air $1.00/lb. **minimum charge $3.00** Prices quoted are for pre-paid orders only

Circle 165 on inquiry card.

California Digital

Post Office Box 3097 B • Torrance, California 90503



FREE

Plastic library case supplied with all diskettes purchased from California Digital.

DISKETTES AS LOW AS $16.50

FIVE INCH SINGLE SIDED DOUBLE DENSITY

	SoftSector / TenSector / Sixteen	Each box	10 Boxes	100 Boxes
CAL DIGITAL	CAL-501 / CAL-510 / CAL-516	19.95	18.50	16.50
SCOTCH	MMM-744/0 / MMM-744/10 / MMM-744/16	26.50	24.50	21.75
VERBATIM	VRB-525/01 / VRB-525/10 / VRB-525/16	26.50	25.25	23.50
MEMOREX	MRX-3481 / MRX-3483 / MRX-3485	26.50	22.25	18.75
MAXELL	MXL-MD1 / MXL-MH1/10 / MXL-MH1/16	26.50	24.50	23.25
DYSAN	DYS-104/1D / DYS-107/1D / DYS-105/1D	35.00	33.00	30.50

FIVE INCH DOUBLE SIDED DOUBLE DENSITY

CAL DIGITAL	CAL-551 / CAL-561 / N/A	24.95	22.75	20.50
SCOTCH	MMM-745/0 / MMM-745/10 / MMM-745/16	39.95	37.95	31.25
VERBATIM	VRB-550/01 / VRB-550/10 / VRB-550/16	39.95	37.95	32.75
MEMOREX	MRX-3491 / MRX-3493 / MRX-3495	35.00	31.25	26.25
MAXELL	MXL-MD2 / MXL-MD2/10 / MXL-MD2/16	39.95	37.95	34.75
MAXELL / 96	MXL-MD2/96 / N/A / N/A	45.00	43.00	41.25
DYSAN	DYS-104/2D / DYS-107/2D / DYS-105/2D	42.50	40.50	35.50
DYSAN / 96	DYS-204/2D / N/A / N/A	49.95	47.95	45.75

EIGHT INCH SINGLE SIDED SINGLE DENSITY

SCOTCH	MMM-740/0	29.50	27.50	23.80
MEMOREX	MRX-3062	27.75	26.60	22.25
VERBATIM	VRB-34/9000	31.50	29.50	25.60
DYSAN	DYS-3740/1	35.75	32.75	29.75

EIGHT INCH SINGLE SIDED DOUBLE DENSITY

SCOTCH	MMM-741/0	37.75	35.15	29.15
MEMOREX	MRX-3090	35.50	33.50	27.15
VERBATIM	VRB-34/8000	35.25	33.25	28.75
DYSAN	DYS-3740/1D	40.75	38.75	32.25
MAXELL	MXL-FD1	45.50	39.75	35.15

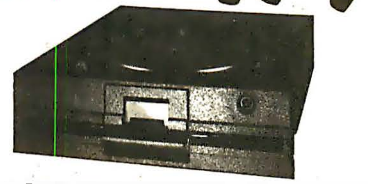
EIGHT INCH DOUBLE SIDED DOUBLE DENSITY

SCOTCH	MMM-743/0	47.50	44.25	37.50
MEMOREX	MRX-3102	39.25	36.75	31.50
VERBATIM	VRB-34/4001	41.75	37.50	32.25
DYSAN	DYS-3740/2D	54.65	49.75	40.50
MAXELL	MXL-FD2	52.50	48.75	40.45

MODEMS

Signalman Mark 12, 1200 baud. Hayes compatible.	SGL-MK12	259.00
Signalman Mark 1, direct connect with terminal cable.	SGL-MK1	75.00
CTS 212AH 1200 baud, auto dial, Hayes compatible.	CTS-212AH	319.00
Hayes Smart Modem 1200 baud, auto answer, auto dial	HYS-212AD	479.00
Hayes 1200B for use with the IBM/PC, 1200 baud.	HYS-1200B	429.00
Hayes Smartmodem, 300 baud only, auto answer, auto dial	HYS-103AD	229.00
Hayes Micromodem II, 103 Apple direct connect	HYS-MM2	279.00
Hayes Micromodem 100, S-100 auto answer, auto dial.	HYS-100	319.00
Hayes Chronograph, time & date	HYS-CHR232	199.00
U.S. Robotics 212A 300/1200 baud, auto dial/answer.	USR-212A	439.00
U.S. Robotics Password 300/1200 baud	USR-PW212	389.00
Penril 300/1200 auto dial, autolog	PEN-12AD	695.00
Universal Data 103LP, line power, answer & originate	UDS-103LP	169.00
Universal Data 103LPJ, Auto answer	UDS-103LPJ	219.00
Universal Data 202, 1200 baud, half duplex only	UDS-202LP	219.00
Universal Data 212LP, full 1200 baud duplex, line power	UDS-212LP	359.00
Novation 'J' Cat, direct connect, auto answer	NOV-JCAT	115.00
Novation Cat, acoustic connect	NOV-CAT	159.00
Novation SmartCat 103, auto answer, auto dial	NOV-SC103	219.00

MITSUBISHI 96 TPI • 4853 $179



California Digital has purchased over one thousand **factory new** Mitsubishi M4853 5¼" disk drives from the Eagle Computer Company. The drives are half height double sided 96 track per inch. The M4853 interfaces the same as the Shugart SA465. We are currently offering these drives at only $179.00. This is far below distributor cost. Offer is subject to remaining inventory on hand at time of order. MIT-4853

MEMORY



16K DYNAMIC **1.95** 4116 150ns.	2732 EPROM **4.95** 450ns.
2764 EPROM **6.95** 350ns.	16K STATIC **4.95** 6116 200ns.

4164 DYNAMIC MEMORY 150ns $5.95

DYNAMIC MEMORY

		1-31	32 +	100 +
40274K dynamic 250ns.	ICM-4027250	1.99	1.85	1.75
4116 150ns.16K	ICM-4116150	1.75	1.65	1.45
4116 200ns.16K	ICM-4116200	1.75	1.65	1.45
4164 150ns.64K 128 refresh	ICM-4164150	5.95	5.85	5.55
41256 150ns. 256K	ICM-41256150		Available	
DP8409 dynamic controller	ICT-8409	39.00	35.00	29.00

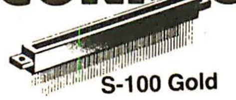
EPROMS

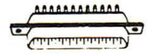
2708450ns. 1K x 8	ICE-2708	4.95	4.75	4.55
2716 450ns. 2K x 8	ICE-2716	4.50	4.25	3.97
2716TMS 450ns. Tri-voltage	ICE-2716TMS	7.95	7.65	7.25
2732450ns. 4K x 8	ICE-2732	4.50	3.75	3.55
2732350ns.4K x 8	ICE-2732350	8.50	8.00	7.60
2532450ns.4K x 8	ICE-2532	10.50	9.90	9.50
2764350ns.8K x 8	ICE-2764	6.95	6.95	6.95
27128 350ns. 16K x 8	ICE-27128	18.95		

STATIC MEMORY

21L02 200ns. 1K static	ICM-21L02200	1.49	1.29	1.15
21L02 450ns. 1K static	ICM-21L02450	1.29	1.15	.99
2112 450ns. 2K static	ICM-2112450	2.99	2.85	2.75
2114 300ns. 1K x 4	ICM-2114300	1.95	1.85	1.75
4044TMS 450ns. 4K x 1	ICM-4044450	3.49	3.25	2.99
5257 300ns. 4K x 1	ICM-5257300	2.50	2.25	1.99
6116 P4 200ns. 2K x 8	ICM-6116200	4.85	4.65	4.50
6116 P3 150ns. 2K x 8	ICM-6116150	5.25		
6167/2167100ns. 16K x 1 (20pin)	ICM-6167100	9.95		

CONNECTORS





GOLD S-100 EDGE CARD CONNECTORS

	catalog	each	10-99	100+
Imsai s/t 250	CNE-IMS	2 95	2 50	2 19
Sullins Hi/Rel	CNE-H100	4.19	3 85	3 47
S-100 WireW	CNE-W10	3 95	3 50	3.19
Altair .140" s/t	CNE-100A	4 95	4 50	4 19

.156" CENTER EDGE CARD CONNECTORS

22/44 Eyelet	CNE-44E	2 50	2 15	1 95
43/72 Moto s/t	CNE-72S	6.60	6 15	5 75
36/72 D/G s/t	CNE-72S	5 95	5 50	5 19

Other connectors available upon request.

RIBBON CONNECTORS

DB25P male	CND-r25P	565	5 25	4 15
DB25S female	CND-r25S	595	5 59	4 50
57-30360 male	CNC-r36P	795	6 75	590
57-30360 female	CNC-r36S	795	6 75	5 90
20pin edge	CNI-DE20	435	3 30	2 50
20pin socket	CNI-DS20	2 75	1 85	1 60
26pin edge	CNI-DE26	4 95	3 50	2 70
26pin socket	CNI-DS26	3 50	2 40	2 15
34pin edge	CNI-DE34	495	4 50	3 50
34pin socket	CNI-DS34	4 50	3 95	3 15
50pin edge	CNI-DE50	5 95	5 60	4 90
50pin socket	CNI-DS50	4 95	4 60	3 80

"D" TYPE

	catalog.	each	10-99	100+
DE9P male	CND-9P	1 60	1 40	1 30
DE9S female	CND-9S	2 25	2.00	1 30
DE hood	CND-9H	1.50	1 35	1 20
DA15P male	CND-15P	2.35	2.10	1.90
DA15S female	CND-15S	3 25	3.10	290
DA15 hood	CND-15H	1 60	1.35	1 30
DB25P male	CND-25P	1 95	1.75	1 35
DB25S female	CND-25S	295	2.55	1.65
DB25 hood	CND25H	1 35	1.15	.77
DC37P male	CND-37P	4 20	3.95	365
DC37S female	CND-37S	5.95	5.75	5 50
DC37 hood	CND-37H	2 25	1 95	1 65
DD50P male	CND-50P	5 50	5 10	4 75
DD50 hood	CND-50H	2 60	2.40	2 10
Hardware 2/set	CND-2HS	89	69	42

AMPHENOL / CENTRONICS TYPE

57-3036036/P	CNC-36P	795	6.35	3.97
IEEE488. C dor	CND-24P	7 95	6 35	5.35

DISK DRIVE POWER CONNECTORS

8 6 pin D.C.	CNP-6DC	1 95	1 29	89
8 3AC Sgl/S	CNP-3SS	169	1 09	69
8 3AC Dbl/S	CNP-3DS	1.69	1.09	69
5¼ 4 pin D.C.	CNP-4DC	1.79	1.19	.99
3pin DIN recpt.	CNP-D3P	2.59	1.99	1.59

BLOWOUT SALE $129



California Digital has recently participated in the purchase of several thousand Siemens FDD 100-8 floppy disk drives. These units are electronically and physically similiar to that of the Shugart 801R. All units are new and shipped in factory sealed boxes. Manual and power connectors supplied free upon request. Your choice 115 Volt. 60 Hz. or 230 Volt. 50Hz.

NOTE! European customers, we have a large quantity of 230 volt 50 Hz. units warehoused in Frankfort Germany. Arrangements can be made to will call these drives in quantities of 50 or more in Frankfort reducing import duty and freight charges.

REMEX DOUBLE SIDED $219

California Digital has just purchased a large quantity of Remex RFD-4000 **Eight inch double sided** disk drives. Remex is the only double sided disk drive that has an double gimbal mounted head assembly that guaranties lower head tracking. This drive is mechanically solid. Remex has always been known for producing premiere products for the floppy disk market. The Remex company is a subsidiary of the Ex-cell-o Corporation, a Fortune 500 Company

Eight Inch Single Sided Drives

	One	Two	Ten
SHUGART 801R	385	375	365
SIEMENS FDD 100-8	129	125	119
TANDON 848E-1 Half Height	369	359	349

Eight Inch Double Sided Drives

SHUGART SA851R	495	485	475
QUME 842 "QUME TRACK 8"	459	459	449
TANDON 848E-2 Half Height	459	447	435
REMEX RFD-4000	219	219	209
MITSUBISHI M2894-63	447	439	433
MITSUBISHI M2896-63 Half Ht.	459	449	409

Five Inch Single Sided Drives

TEAC FD-55A half height	159	149	139
SHUGART SA400L	199	189	185
SHUGART SA200 ⅔ Height	159	149	139
TANDON TM100-1	189	179	175

Five Inch Double Sided Drives

TEAC FD55B half height	179	169	165
CONTROL DATA 9409 IBM/PC	229	219	215
SHUGART SA450	319	309	299
SHUGART SA455 Half Height	259	249	239
PANASDNIC JA551/2N (SA455)	169	159	155
SHUGART SA465 Half Ht. 96TPI	289	279	269
TANDON TM50-2 Half Height	215	209	199
TANDON TM55-4 half Ht. 96TPI	329	319	309
TANDON 100-2	279	269	259
TANDDN 101-4 96TPI 80 Track	369	355	350
MITSUBISHI 4851 Half Height	259	249	245
MITSUBISHI 4853 ½ Ht. 96TPI	179	175	169
MITSUBISHI 4854 ½ Ht., 8" elec.	465	449	439
QUME 142 Half Height	239	229	219

Three Inch Disk Drives

SHUGART SA300 with diskette	229	219	209

Five Inch Winchester Hard Disk Drives

FUJITSU M2235AS	27 M/Bytes	999	959	889
RODINE RO-208	53 M/Byte	1589	1493	1427
SHUGART 712	13 M/Byte, ½ Ht	795	765	725
TANDON 503	19 M/Byte	735	775	755

Upon request, all drives are supplied with power connectors and manual

ENCLOSURES

California Digital manufactures an asortment of stock and custom disk drive enclosures. If the volume is justified we will custom design an enclosure for your application. The following stock disk drive enclosures are available. All include power suoplies the 8" enclosures are supplied with exhaust fans.

Horizontal mount two 8" full height drives. $279.00

Vertical mount two full height 8" disk drives. $299.00

Horizontal mount one full height or two half height 8" disk drives. $239.00

Vertical mount two full height 5¼" disk drives $139.00

Telex 753607

VISA

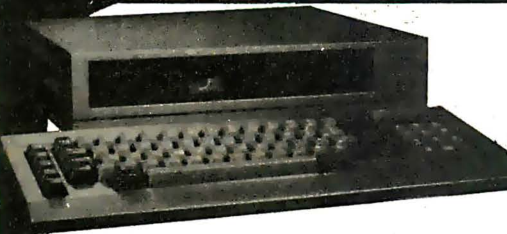
master charge

Shipping: First five pounds $3.00, each additional pound $.50.
Foreign orders: 10% shipping, excess will be refunded.
California residents add 6½% sales tax. ● COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a strong "Dun & Bradstreet" rating.
Retail location: 17700 Figueroa Street, Carson CA. 90248.

TOLL FREE ORDER LINE
(800) 421-5041
TECHNICAL & CALIFORNIA
(213) 217-0500

California Digital

Post Office Box 3097 B • Torrance, California 90503



FREE

Your Choice
Second Drive or Monitor

SANYO

IBM COMPATIBLE

$895

The Sanyo MBC-550 Microcomputer includes 128K byte of memory, a 5¼" disk drive along with a parallel printer port. The computer outputs both RGB color and monochrome composite video. Extensive software such as Sanyo Basic, Wordstar, Calcstar and Easy Writer I is included with the MBC-550.

Along with all this California Digital offers "FREE" your choice of either a second disk drive, or a high resolution green or amber screen monitor. All at the super low price of only $895.

Double sided 320K/byte disks drives are available at only $99 per drive additional.

IBM PC

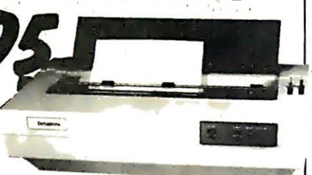
$1899



System I includes 64K byte of memory one 320K byte double sided disk drive, and keyboard. Monitor and monitor interface available. System II includes 256K byte of memory two 320K byte disk drives, Sakata color monitor. Peacock color card with printer port all for only $2899.

PRINTERS

$595



The RICOH RP1300 is a 35 cps word processing daisy wheel printer ruggedly constructed assuring you of a long trouble free life. Besides its speed, it also features 16" platen, bi-directional printing, proportional spacing, bold print, shadow print, automatic underscore, forward and reverse linefeed, plus other user programmable features. Making the RP1300 a "Best Buy" among OEM system integrators.

The printer is supplied with printwheel, ribbon, and paper guide. Supplies are available from any Radio Shack Computer Center as well as many local stationary stores.

This printer is an OEM type originally manufactured for the Dictaphone Corporation. It is available with an RS-232 serial interface only. Interfacing documentation along with special Wordstar software driver suitable for the IBM/PC and IBM look-a-likes is included. RIC-1300 $595.

MATRIX PRINTERS

Star Gemini-10X 120 char/sec.	STR-G10X	279.00
Star Gemini-15X, 100 char./sec. 15" paper.	STR-G15X	389.00
Star Gemini Delta 10, 160 Char/sec	STR-D10	399.00
Star Coex80FT friction & tractor	VST-C80FT	195.00
Toshiba P1350, 192 char/sec. letter quality	TOS-1350	1495.00
Okidata 82A serial & parallel 9½" paper	OKI-82A	347.00
Okidata 92A parallel interface, 160 char/sec.	OKI-92A	427.00
Okidata 83A & parallel 15" paper	OKI-83A	567.00
Okidata 84A & parallel 15" paper	OKI-84A	997.00
Okidata 2350 (new) 350 char/sec	OKI-2350	1995.00
Epson RX-80 10" 120 Char/sec.	EPS-RX80	317.00
Epson FX80, 10" 160 char./sec. with graphtrax	EPS-FX80	529.00
Epson FX 100 15" 160 char./sec with graphtrax	EPS-FX100	719.00
Epson MX100 with graphtrax, 15" paper	EPS-MX100	589.00
NEC8023A parallel 9½" paper, graphics	NEC-8023A	389.00
Anadex 9501B high speed with graphics	ADX-9501B	1029.00
Anadex 9620B 200 char/sec. par'l & serial	ADX-9620B	1129.00
Quantex 7030 corespondence quality 180 char/sec.	QTX-7030	1539.00
Prowriter 8510 parallel 9½" paper	PRO-8510P	359.00
Prowriter II, parallel 15" paper, graphics	PRO-2P	689.00
Dataproducts B-600-3, band printer 600 LPM	DPS-B600	6985.00
Printronix P300 high speed printer 300 lines per minute	PTX-P300	4250.00
Printronix P600 ultra high speed 600 lines per minute	PTX-P600	5795.00

WORD PROCESSING PRINTERS

NEC7710 55 char/second, serial interface	NEC-7710	1979.00
NEC7730 55 char/sec. par'l interface.	NEC-7730	1979.00
NEC3550 popular printer designed for the IBM/PC	NEC-3550	1799.00
NEC2050 designed for IBM/PC 20 char/sec. par'l.	NEC-20 50	995.00
Silver Reed EXP500, 14 char/sec. par'l interface	SRD-EX P500	459.00
Silver Reed EXP550 17 Char/sec par'l interface.	SRD-EXP550	659.00
Diablo 630 40 char/sec. serial	DBL-630	1765.00
Diablo 620, proportional spacing, horz & vert. tab. 20cps.	DBL-620	879.00
Juki 6100, 18 char./sec. graphic mode	JUK-6100	495.00
Brother HR1A daisy wheel, parallel interface	BTH-HR1P	695.00
Brother HR1A serial interface	BTH-HR1S	695.00
Starwriter F10 serial, 40 char/sec.	PRO-F10S	1125.00
Starwriter F10 parallel, 40 char/sec.	PRO-F10P	1125.00
Comrex CR1 word processing printer, serial intr.	CRX-CR1S	729.00
Comrex CR2, 5k buffer, proporional spacing, par'l	CRX-CR2P	495.00

MONITORS

BMC 12A green phosphor 15 MHz composit video	BMC-12A	78.95
BMC 12" high resolution 20MHz	BMC-12EN	119.00
Amdek 300G 12" green phosphor	AMK-300G	128.95
Amdek 300A 12" amberphos., hi-resolution	AMK-300A	138.95
Amdek 310A designed for IBM/PC, amber	AMK-310A	158.95
Zenith ZVM122 Amber Phosphor 12" 40/80 column switch.	ZTH-122	94.95
Zenith ZVM123 green phosphor 12" 40/80 column switch.	ZTH-Z123	94.95
NEC JB1201 green phosphor 18 MHz. composit video.	NEC-JB1201	159.00
NEC JB1260 commercial grade composit.	NEC-JB1260	119.00
USI Amber screen 12" composit monitor.	USI-12A	99.00
Motorola 23" open frame blk/white composit video.	MOT-BW23	159.00
Motorola 12" open frame requires horz sync. and power.	MOT-BW12	69.00
Conrac 9" open frame requires horz sync. & 12v. supply.	CON-BW9	59.00
COLOR		
BMC AU9191U Color composit video with sound	BMC-9191	238.95
BMC 9191M RGB designed for use with the IBM computer.	BMC-9191M	379.00
NEC JC1203DM, RGB color monitor	NEC-1203	699.00
NEC JC1201 color composit.	NEC-JC1201	339.00
Zenith ZVM135 RGB & composite suitable for IBM PC	ZTH-Z135	475.00
Amdek Color I, 13" composit video	AMK-100	299.00
Amdek Color II - , 13" RGB hi/resolution.	AMK-200	419.95
Amdek Color III - , 13" RGB, medium resolution	AMK-300	359.95
Princeton HX-12 RGB IBM/PC compatible	PRN-HX12	478.95

TERMINALS



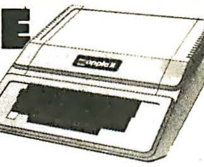
California Digital has recently purchased an OEM liquidation, of new Hazeltine 1420 video terminals. These units feature direct cursor addressing, full 62 key keyboard with numeric cluster, RS-232C with baud rates selectable to 9600. Self diagnostics and escape sequences function mode make this terminal an excellent value at only $299.00. HZL-1420

$299

Hazeltine 1420 Video Display Terminal	HZL-1420	299.00
Freedom 100, split screen, detatchable keyboard	LIB-F100	495.00
Qume 102 green phosphor terminal	QUM-102	539.00
Visual 50 Green screen	VSL-50G	650.00
Ampex Dialogue 125 green screen.	APX-D125G	675.00
Ampex Dialouge 175 amber screen, two page, func. keys	APX-D125A	719.00
Wyse 50, 14" greenphosphor	WYS-50	595.00
Wyse 100, horz & vert. split screen, metal enclosure	WYS-100	795.00
Wyse 300, Eight color display, splitscreen	WYS-300	1159.00
Televideo 910 Plus, block mode	TVI-910P	575.00
Televideo 925, detatchable keyboard, 22 function keys	TVI-925	759.00
Televideo 950, graphic char., split screen, 22 func	TVI-950	950.00
Televideo 970, 14" green screen, 132 column, European	TVI-970	1095.00
Zenith 29 terminal, VT52 compatible, detatchable keyboard	ZTH-Z29	765.00

APPLE

$929



Apple II/e, 64K computer only	APL-2E	$989
Apple II/e starter kit, monitor, disk, 80 col. card	APL-2ESK	1365
Advanced Busness Tech. 13 Key Pad	ABT-13B	109
Calif. Computer 7710A Async. Serial Interface	CCS-7710	125
Calif. Computer 7710B same but for modem	CCS-7710B	125
Calif. Computer 7114A 12K PROM module	CCS-7114	99
Calif. Computer 7720A parallel interface	CCS-7720	99
Calif. Computer 7724A Calandar/clock modual	CCS-7724	99
Calif. Computer 7729A Centronics interface	CCS-7729	99
Calif. Computer 7740A programmable timer	CCS-7740	99
California Digital 16K card for standard Apple II	CAL-A16	39
Hayes Micromodem II for Apple II	HYS-MM2	279
Kensington Micro. System saver fan	KEN-SF1	75
Microsoft Softcard with CP/M: Z-80	MSF-SFTCD	239
Mountain Computer "The Clock"	MTN-TCLK	225
Mountain Computer AD/DA 16 input, 8bit	MTN-ADDA	269
Mountain Computer ROM Plus with keybd. filter	MTN-RMF	169
Mountain Computer ROM writer/socket socket	MTN-ROMW	139
Orange Micro "GRAPPLER" parallel interface	OMS-G2	135
Sorrento Valley 8" controller double side D/D.	SVA223	395
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Vista Vision 80: 80 column card for std. Apple II	VSA-VIS80	289
Vista 8" disk controller double side D/D.	VSA-A800	389

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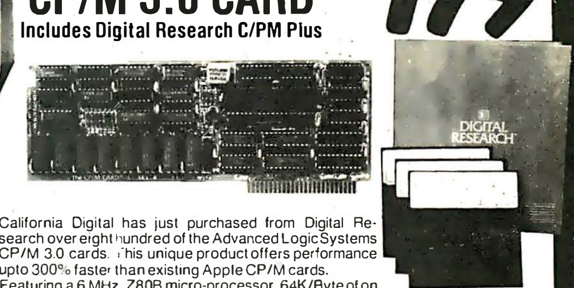
Not pictured, 49 key eight bit modified Hollerith coded Microswitch Hall effect keyboard REMOVED from punch card equipment. $14.95 DIT-KB49 ASCII encoder available

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Includes Digital Research C/PM Plus

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Godbout 8086 8087 microcomp. 16 bit	GBT-8687	495.00
Godbout dual processor 8085 8088 8 16	GBT-8588	359.00

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Teletek System master 765 floppy 64K	TEL-SMT	895.00
Teletek FDC-1 single board no memory	TEL-FDC1	675.00

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California Computer Z80 microprocessor	CCS-2810	275.00
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Morrow Disk Jockey I with CPM sgl. Den	MDS-DJ1	225.00
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Tarbell Electronics single density	TAR-SDC	279.00
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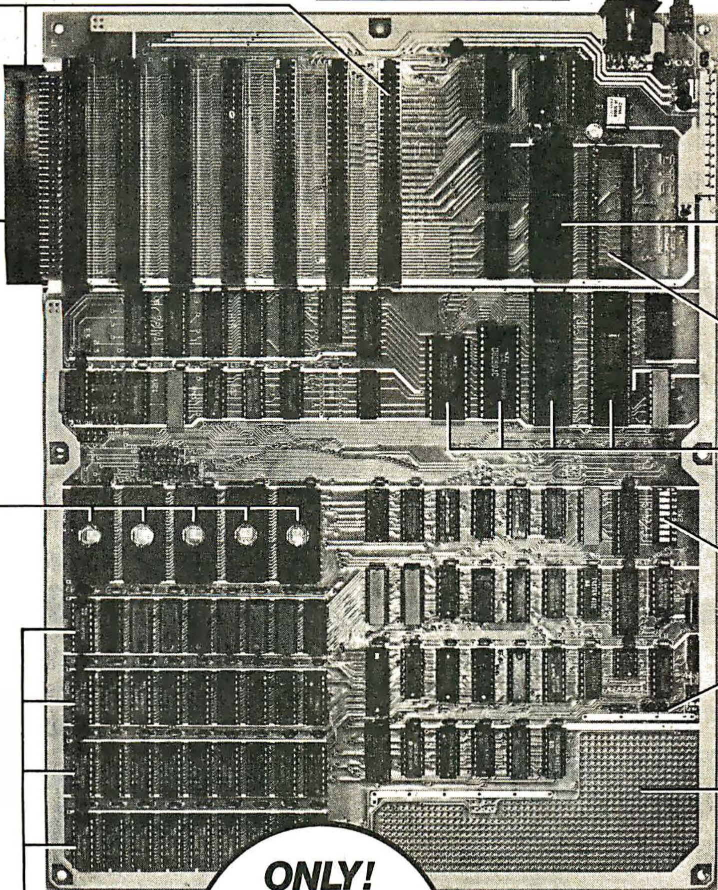
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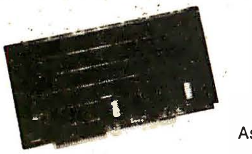
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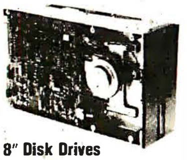
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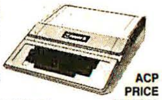
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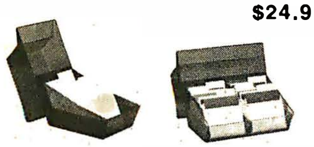
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5.0666	2.69
5.165	2.69
5.7143	2.69
6.0	2.69
6.144	2.69
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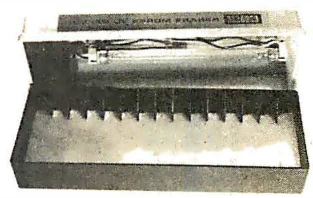
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4164-120	65536 x 1	(120ns) (5v)	6.95
MCM6685	65536 x 1	(200ns) (5v)	8.95
TMS4164-15	65536 x 1	(150ns) (5v)	6.95
TMS4416	16384 x 4	(150ns) (5v)	9.95
41256	262144 x 1	(200ns) (5v)	CALL

5v = Single 5 volt supply

EPROMS

1702	256 x 8	(1us)	4.50
2708	1024 x 8	(450ns)	3.95
2758	1024 x 8	(450ns) (5v)	5.95
2716-6	2048 x 8	(650ns)	2.95
2716	2048 x 8	(450ns) (5v)	3.95
2716-1	2048 x 8	(350ns) (5v)	5.95
TMS2516	2048 x 8	(450ns) (5v)	5.50
TMS2716	2048 x 8	(450ns)	7.95
TMS2532	4096 x 8	(450ns) (5v)	5.95
2732	4096 x 8	(450ns) (5v)	4.95
2732-250	4096 x 8	(250ns) (5v)	8.95
2732-200	4096 x 8	(200ns) (5v)	11.95
2732A-4	4096 x 8	(450ns) (5v) (21vPGM)	6.95
2732A	4096 x 8	(250ns) (5v) (21vPGM)	9.95
2732A-2	4096 x 8	(200ns) (5v) (21vPGM)	13.95
2764	8192 x 8	(450ns) (5v)	6.95
2764-250	8192 x 8	(250ns) (5v)	7.95
2764-200	8192 x 8	(200ns) (5v)	19.95
TMS2564	8192 x 8	(450ns) (5v)	14.95
MCM68764	8192 x 8	(450ns) (5v) (24pin)	39.95
MCM68766	8192 x 8	(350ns) (5v) (24pin)	42.95
27128-30	16384 x 8	(300ns) (5v)	29.95
27128	16384 x 8	(250ns) (5v)	34.95

5v = Single 5 Volt Supply 21vPGM = Program at 21 Volts

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- ★ **Fast service — most orders shipped within 24 hours!**

CRYSTALS

32.768 khz	1.95
1.0 mhz	3.95
1.8432	3.95
2.0	2.95
2.097152	2.95
2.4576	2.95
3.2768	2.95
3.579545	2.95
4.0	2.95
5.0	2.95
5.0688	2.95
5.185	2.95
5.7143	2.95
6.0	2.95
6.144	2.95
6.5536	2.95
8.0	2.95
10.0	2.95
10.738635	2.95
14.31818	2.95
15.0	2.95
16.0	2.95
17.430	2.95
18.0	2.95
18.432	2.95
20.0	2.95
22.1184	2.95
32.0	2.95

UARTS

AY5-1013	3.95
AY3-1015	6.95
PT1472	9.95
TR1602	3.95
2350	9.95
2651	8.95
IM6402	7.95
IM6403	8.95
INS8250	10.95

GENERATORS

BIT-RATE

MC14411	11.95
BR1941	11.95
4702	12.95
COM5016	16.95
COM8116	10.95
MM5307	10.95

FUNCTION

MC4024	3.95
LM566	1.49
XR2206	3.75
8038	3.95

MISC.

UPD7201	29.95
TMS99532	29.95
ULN2003	2.49
3242	7.95
3341	4.95
MC3470	4.95
MC3480	9.00
11C90	13.95
95H90	7.95
2513-001 UP	9.95
2513-002 LOW	9.95

CLOCK CIRCUITS

MM5314	4.95
MM5369	3.95
MM5369-EST	4.25
MM5375	4.95
MM58167	12.95
MM58174	11.95
MSM5832	3.95

KEYBOARD CHIPS

AY5-2376	11.95
AY5-3600	11.95
AY5-3600 PRO	11.95

CMOS

4000	.29	4528	1.19
4001	.25	4531	.95
4002	.25	4532	1.95
4006	.89	4538	1.95
4007	.29	4539	1.95
4008	.95	4541	2.64
4009	.39	4543	1.19
4010	.45	4553	5.79
4011	.25	4555	.95
4012	.25	4556	.95
4013	.38	4581	1.95
4014	.79	4582	1.95
4015	.39	4584	.75
4016	.39	4585	.75
4017	.69	4702	12.95
4018	.79	74C00	.35
4019	.39	74C02	.35
4020	.75	74C04	.35
4021	.79	74C08	.35
4022	.79	74C10	.35
4023	.29	74C14	.59
4024	.65	74C20	.35
4025	.29	74C30	.35
4026	1.65	74C32	.39
4027	.45	74C42	1.29
4028	.69	74C48	1.99
4029	.79	74C73	.65
4030	.39	74C74	.65
4034	1.95	74C76	.80
4035	.85	74C83	1.95
4040	.75	74C85	1.95
4041	.75	74C86	.39
4042	.69	74C89	4.50
4043	.85	74C90	1.19
4044	.79	74C93	1.75
4046	.85	74C95	.99
4047	.95	74C107	.89
4049	.35	74C150	5.75
4050	.35	74C151	2.25
4051	.79	74C154	3.25
4053	.79	74C157	1.75
4060	.89	74C160	1.19
4066	.39	74C161	1.19
4068	.39	74C162	1.19
4069	.29	74C163	1.19
4070	.35	74C164	1.39
4071	.29	74C165	2.00
4072	.29	74C173	.79
4073	.29	74C174	1.19
4075	.29	74C175	1.19
4076	.79	74C192	1.49
4078	.29	74C193	1.49
4081	.29	74C195	1.39
4082	.29	74C200	5.75
4085	.95	74C221	1.75
4086	.95	74C244	2.25
4093	.49	74C373	2.45
4098	2.49	74C374	2.45
4099	1.95	74C901	.39
14409	12.95	74C902	.85
14410	12.95	74C903	.85
14411	11.95	74C905	10.95
14412	12.95	74C906	.95
14419	7.95	74C907	1.00
14433	14.95	74C908	2.00
4502	.95	74C909	2.75
4503	.65	74C910	9.95
4508	1.95	74C911	8.95
4510	.85	74C912	8.95
4511	.85	74C914	1.95
4512	.85	74C915	1.19
4514	1.25	74C918	2.75
4515	1.79	74C920	17.95
4516	1.55	74C921	15.95
4518	.89	74C922	4.49
4519	.39	74C923	4.95
4520	.79	74C925	5.95
4522	1.25	74C926	7.95
4526	1.25	74C928	7.95
4527	1.95	74C929	19.95

6800

68000	49.95
6800	2.95
6802	7.95
6803	19.95
6808	13.90
6809E	14.95
6809	11.95
6810	2.95
6820	4.35
6821	2.95
6828	14.95
6840	12.95
6843	34.95
6844	25.95
6845	14.95
6847	11.95
6850	3.25
6852	5.75
6860	7.95
6875	6.95
6880	2.25
6883	22.95
68047	24.95
68488	19.95

6800 = 1MHZ

68B00	10.95
68B02	22.25
68B09E	29.95
68B09	29.95
68B10	6.95
68B21	6.95
68B40	19.95
68B45	19.95
68B50	5.95

68B00 = 2 MHZ

6500

1 MHZ

6502	4.95
6504	6.95
6505	8.95
6507	9.95
6520	4.35
6522	6.95
6532	9.95
6545	22.50
6551	11.85

2 MHZ

6502A	6.95
6522A	9.95
6532A	11.95
6545A	27.95
6551A	11.95

3 MHZ

6502B	9.95

DISC CONTROLLERS

1771	16.95
1791	24.95
1793	26.95
1795	29.95
1797	49.95
2791	54.95
2793	54.95
2795	59.95
2797	59.95
6843	34.95
8272	39.95
UPD765	39.95
MB8876	29.95
MB8877	34.95
1691	17.95
2143	18.95

8000

8035	5.95
8039	5.95
INS-8060	17.95
INS-8073	49.95
8080	3.95
8085	4.95
8085A-2	11.95
8086	24.95
8087	CALL
8088	29.95
8089	89.95
8155	6.95
8155-2	7.95
8156	6.95
8185	29.95
8185-2	39.95
8741	29.95
8748	24.95
8755	24.95

CRT CONTROLLERS

6845	14.95
68B45	19.95
HD46505SP	15.95
6847	11.95
MC1372	6.95
68047	24.95
8275	29.95
7220	99.95
CRT5027	19.95
CRT5037	24.95
TMS9918A	39.95
DP8350	49.95

8200

8202	24.95
8203	39.95
8205	3.50
8212	1.80
8214	3.85
8216	1.75
8224	2.25
8226	1.80
8228	3.49
8237	19.95
8237-5	21.95
8238	4.49
8243	4.45
8250	10.95
8251	4.49
8253	6.95
8253-5	7.95
8255	4.49
8255-5	5.25
8257	7.95
8257-5	8.95
8259	6.90
8259-5	7.50
8271	79.95
8272	39.95
8275	29.95
8279	8.95
8279-5	10.00
8282	6.50
8283	6.50
8284	5.50
8286	6.50
8287	6.50
8288	25.00
8289	49.95
8292	14.95

Z-80

2.5 Mhz

Z80-CPU	3.95
Z80-CTC	3.95
Z80-DART	10.95
Z80-DMA	14.95
Z80-PIO	3.95
Z80-SIO/0	11.95
Z80-SIO/1	11.95
Z80-SIO/2	11.95
Z80-SIO/9	11.95

4.0 Mhz

Z80A-CPU	4.49
Z80A-CTC	4.95
Z80A-DART	9.95
Z80A-DMA	12.95
Z80A-PIO	4.49
Z80A-SIO/0	12.95
Z80A-SIO/1	12.95
Z80A-SIO/2	12.95
Z80A-SIO/9	12.95

6.0 Mhz

Z80B-CPU	9.95
Z80B-CTC	12.95
Z80B-PIO	12.95
Z80B-DART	19.95
Z80B-SIO/2	39.95

ZILOG

Z6132	34.95
Z8671	39.95

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TMM2016 2K x 8 STATIC 200 ns $4.15 HM6264 8K x 8 STATIC 150 ns $39.95

74LS00

74LS00	.24	74LS173	.69
74LS01	.25	74LS174	.55
74LS02	.25	74LS175	.55
74LS03	.25	74LS181	2.15
74LS04	.24	74LS189	8.95
74LS05	.25	74LS190	.89
74LS08	.28	74LS191	.89
74LS09	.29	74LS192	.79
74LS10	.25	74LS193	.79
74LS11	.35	74LS194	.69
74LS12	.35	74LS195	.69
74LS13	.45	74LS196	.79
74LS14	.59	74LS197	.79
74LS15	.35	74LS221	.89
74LS20	.25	74LS240	.95
74LS21	.29	74LS241	.99
74LS22	.25	74LS242	.99
74LS26	.29	74LS243	.99
74LS27	.29	74LS244	1.29
74LS28	.35	74LS245	1.49
74LS30	.25	74LS247	.75
74LS32	.29	74LS248	.99
74LS33	.55	74LS249	.99
74LS37	.35	74LS251	.59
74LS38	.35	74LS253	.59
74LS40	.25	74LS257	.59
74LS42	.49	74LS258	.59
74LS47	.75	74LS259	2.75
74LS48	.75	74LS260	.59
74LS49	.75	74LS266	.55
74LS51	.25	74LS273	1.49
74LS54	.29	74LS275	3.35
74LS55	.29	74LS279	.49
74LS63	1.25	74LS280	1.98
74LS73	.39	74LS283	.69
74LS74	.35	74LS290	.89
74LS75	.39	74LS293	.89
74LS76	.39	74LS295	.99
74LS78	.49	74LS298	.89
74LS83	.60	74LS299	1.75
74LS85	.69	74LS323	3.50
74LS86	.39	74LS324	1.75
74LS90	.55	74LS352	1.29
74LS91	.89	74LS353	1.29
74LS92	.55	74LS363	1.35
74LS93	.55	74LS364	1.95
74LS95	.75	74LS365	.49
74LS96	.89	74LS366	.49
74LS107	.39	74LS367	.45
74LS109	.39	74LS368	.45
74LS112	.39	74LS373	1.39
74LS113	.39	74LS374	1.39
74LS114	.39	74LS375	.95
74LS122	.45	74LS377	1.39
74LS123	.79	74LS378	1.18
74LS124	2.90	74LS379	1.35
74LS125	.49	74LS385	3.90
74LS126	.49	74LS386	.45
74LS132	.59	74LS390	1.19
74LS133	.59	74LS393	1.19
74LS136	.39	74LS395	1.19
74LS137	.99	74LS399	1.49
74LS138	.55	74LS424	2.95
74LS139	.55	74LS447	.95
74LS145	1.20	74LS490	1.95
74LS147	2.49	74LS624	3.99
74LS148	1.35	74LS640	2.20
74LS151	.55	74LS645	2.20
74LS153	.55	74LS668	1.69
74LS154	1.90	74LS669	1.89
74LS155	.69	74LS670	1.49
74LS156	.69	74LS674	14.95
74LS157	.65	74LS682	3.20
74LS158	.59	74LS683	3.20
74LS160	.69	74LS684	3.20
74LS161	.65	74LS685	3.20
74LS162	.69	74LS688	2.40
74LS163	.65	74LS689	3.20
74LS164	.69	81LS95	1.49
74LS165	.95	81LS96	1.49
74LS166	1.95	81LS97	1.49
74LS168	1.75	81LS98	1.49
74LS169	1.75	25LS2521	2.80
74LS170	1.49	25LS2569	4.25

74S00

74S00	.32	74S124	2.75	74S197	1.49
74S02	.35	74S132	1.24	74S201	6.95
74S03	.35	74S133	.45	74S225	7.95
74S04	.35	74S134	.50	74S240	2.20
74S05	.35	74S135	.89	74S241	2.20
74S08	.35	74S138	.85	74S244	2.20
74S09	.40	74S139	.85	74S251	.95
74S10	.35	74S140	.55	74S253	.95
74S11	.35	74S151	.95	74S257	.95
74S15	.35	74S153	.95	74S258	.95
74S20	.35	74S157	.95	74S260	.79
74S22	.35	74S158	.95	74S273	2.45
74S30	.35	74S161	1.95	74S280	1.95
74S32	.40	74S162	1.95	74S287	1.90
74S37	.88	74S163	1.95	74S288	1.90
74S38	.85	74S168	3.95	74S289	6.89
74S40	.35	74S169	3.95	74S301	6.95
74S51	.35	74S174	.95	74S373	2.45
74S64	.40	74S175	.95	74S374	2.45
74S65	.40	74S181	3.95	74S387	1.95
74S74	.50	74S182	2.95	74S412	2.98
74S85	1.99	74S188	1.95	74S471	4.95
74S86	.50	74S189	6.95	74S472	4.95
74S112	.50	74S194	1.49	74S474	4.95
74S113	.50	74S195	1.49	74S570	2.95
74S114	.55	74S196	1.49	74S571	2.95

VOLTAGE REGULATORS

7805T	.75	7905T	.85
78M05C	.35	7908T	.85
7808T	.75	7912T	.85
7812T	.75	7915T	.85
7815T	.75	7924T	.85
7824T	.75	7905K	1.49
7805K	1.39	7912K	1.49
7812K	1.39	7915K	1.49
7815K	1.39	7924K	1.49
7824K	1.39	79L05	.79
78L05	.69	79L12	.79
78L12	.69	79L15	.79
78L15	.69	LM323K	4.95
78H05K	9.95	UA78S40	1.95
78H12K	9.95		

C, T = TO-220 K = TO-3
L = TO-92

7400

7400	.19	74123	.49
7401	.19	74125	.45
7402	.19	74126	.45
7403	.19	74132	.45
7404	.19	74136	.50
7405	.25	74143	4.95
7406	.29	74145	.60
7407	.29	74147	1.75
7408	.24	74148	1.20
7409	.19	74150	1.35
7410	.19	74151	.55
7411	.25	74153	.55
7413	.35	74154	1.25
7414	.49	74155	.75
7416	.25	74157	.55
7417	.25	74159	1.65
7420	.19	74160	.85
7421	.35	74161	.69
7425	.29	74163	.69
7427	.29	74164	.85
7430	.19	74165	.85
7432	.29	74186	1.00
7437	.29	74167	2.95
7438	.29	74170	1.65
7442	.49	74173	.75
7445	.89	74174	.89
7446	.69	74175	.89
7447	.69	74177	.75
7448	.69	74181	2.25
7451	.23	74184	2.00
7473	.34	74185	2.00
7474	.33	74191	1.15
7475	.45	74192	.79
7476	.35	74193	.79
7482	.95	74194	.85
7483	.50	74195	.85
7485	.59	74197	.75
7486	.35	74198	1.35
7489	2.15	74221	1.35
7490	.35	74246	1.35
7492	.50	74247	1.25
7493	.35	74259	2.25
7495	.55	74273	1.95
7497	2.75	74276	1.25
74100	1.75	74279	.75
74107	.30	74366	.65
74109	.45	74367	.65
74116	1.55	74368	.65
74121	.29	74393	1.35
74122	.45		

SOUND CHIPS

76477	3.95	AY3-8910	12.95
76488	5.95	AY3-8912	12.95
76489	8.95	MC3340	1.49
SSI-263	39.95		

BYPASS CAPS

.01 UF DISC	100/6.00
.01 UF MONOLITHIC	100/12.00
.1 UF DISC	100/8.00
.1 UF MONOLITHIC	100/15.00

EPROM ERASERS

SPECTRONICS CORPORATION

	Timer	Capacity Chip	Intensity (uW/Cm²)	
PE-14		9	8,000	83.00
PE-14T	X	9	8,000	119.00
PE-24T	X	12	9,600	175.00
PL-265T	X	30	9,600	255.00
PR-125T	X	25	17,000	349.00
PR-320T	X	42	17,000	595.00

INTERFACE

8T26	1.59
8T28	1.89
8T95	.89
8T96	.89
8T97	.89
8T98	.89
DM8131	2.95
DP8304	2.29
DS8833	2.25
DS8835	1.99
DS8836	.99
DS8837	1.65
DS8838	1.30

VISA

MasterCard

DATA ACQUISITION

ADC0800	15.55	DAC0800	4.95
ADC0804	3.49	DAC0808	2.95
DAC0806	1.95	DAC1020	8.25
ADC0809	4.49	DAC1022	5.95
ADC0816	14.95	MC1408L6	1.95
ADC0817	9.95	MC1408L8	2.95

CONNECTORS

RS232 Male	2.50
RS232 Female	3.25
RS232 Hood	1.25
S-100 ST	3.95

EXAR

XR 2206	3.75
XR 2207	3.75
XR 2208	3.75
XR 2211	5.25
XR 2240	3.25

INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	3.95
ICM7207A	5.59
ICM7208	15.95

9000

9316	1.00
9334	2.50
9368	3.95
9401	9.95
9601	.75
9602	1.50
96S02	1.95

LINEAR

LM301	.34	LM348	.99	LM567	.89	LM1812	8.25
LM301H	.79	LM350K	4.95	NE570	3.95	LM1830	3.50
LM307	.45	LM350T	4.60	NE571	2.95	LM1871	5.49
LM308	.69	LM358	.69	NE590	2.50	LM1872	5.49
LM308H	1.15	LM359	1.79	NE592	2.75	LM1877	3.25
LM309H	1.95	LM376	3.75	LM709	.59	LM1889	1.95
LM309K	1.25	LM377	1.95	LM710	.75	LM1896	1.75
LM310	1.75	LM378	2.50	LM711	.79	ULN2003	2.49
LM311	.64	LM379	4.50	LM723	.49	LM2877	2.05
LM311H	.89	LM380	.89	LM723H	.55	LM2878	2.25
LM312H	1.75	LM380N-8	1.10	LM733	.98	LM2900	.85
LM317K	3.95	LM381	1.60	LM741	.35	LM2901	1.00
LM317T	1.19	LM382	1.60	LM741N-14	.35	LM2917	2.95
LM318	1.49	LM383	1.95	LM741H	.40	LM3900	.59
LM318H	1.59	LM384	1.95	LM747	.69	LM3905	1.25
LM319H	1.90	LM386	.89	LM748	.59	LM3909	.98
LM319	1.25	LM387	1.40	LM1014	1.19	LM3911	2.25
LM320 (see 7900)		LM389	1.35	LM1303	1.95	LM3914	3.95
LM322	1.65	LM390	1.95	LM1310	1.49	LM3915	3.95
LM323K	4.95	LM392	.69	MC1330	1.69	LM3916	3.95
LM324	.59	LM393	1.29	MC1349	1.89	MC4024	3.95
LM329	.65	LM394H	4.60	MC1350	1.19	MC4044	4.50
LM331	3.95	LM399H	5.00	MC1358	1.69	RC4136	1.25
LM334	1.19	NE531	2.95	MC1372	6.95	RC4151	3.95
LM335	1.40	NE555	.34	LM1414	1.59	LM4250	1.75
LM336	1.75	NE556	.65	LM1458	.59	LM4500	3.25
LM337K	3.95	NE558	1.50	LM1488	.69	RC4558	.69
LM337T	1.95	NE561	24.95	LM1489	.69	LM13080	1.29
LM338K	6.95	NE564	2.95	LM1496	.85	LM13600	1.49
LM339	.99	LM565	.99	LM1558H	3.10	LM13700	1.49
LM340 (see 7800)		LM566	1.49	LM1800	2.37	MPQ2907	1.95

H = TO-5 CAN T = TO-220 K = TO-3

RCA

CA 3023	2.75	CA 3082	1.65
CA 3039	1.29	CA 3083	1.55
CA 3046	1.25	CA 3086	.80
CA 3059	2.90	CA 3089	2.99
CA 3060	2.90	CA 3096	3.49
CA 3065	1.75	CA 3130	1.30
CA 3080	1.10	CA 3140	1.15
CA 3081	1.65	CA 3146	1.85
CA 3160	1.19		

TI

TL494	4.20	75365	1.95
TL496	1.65	75450	.59
TL497	3.25	75451	.39
75107	1.49	75452	.39
75110	1.95	75453	.39
75150	1.95	75454	.39
75154	1.95	75491	.79
75188	1.25	75492	.79
75189	1.25	75493	.89
75494	.89		

BI FET

TL071	.79	TL084	2.19
TL072	1.19	LF347	2.19
TL074	2.19	LF351	.60
TL081	.79	LF353	1.00
TL082	1.19	LF355	1.10
TL083	1.19	LF356	1.10
LF357	1.40		

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SINCERELY,

D. MARK BABCOCK, DMD

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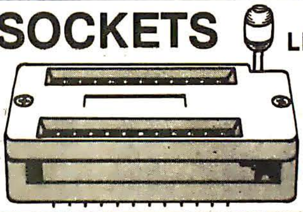
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ZIF = Zero Insertion Force



LEADS	UNIT PRICE
14	5.95
16	5.95
24	7.95
28	8.95
40	10.95

OPTO-ISOLATORS

4N26	1.00	MCA-7	4.25
4N27	1.10	MCA-255	1.75
4N26	.69	IL-1	1.25
4N33	1.75	ILA-30	1.25
4N35	1.25	ILQ-74	2.75
4N37	1.25	H11C5	1.25
MCT-2	1.00	TIL-111	1.00
MCT-6	1.50	TIL-113	1.75

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¼ WATT 5% CARBON FILM
ALL STANDARD VALUES
FROM 1 OHM TO 10 MEG OHM

50 PCS. SAME VALUE	.025
100 PCS. SAME VALUE	.02
1000 PCS. SAME VALUE	.015

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.01 UF DISC	100/6.00
.01 UF MONOLITHIC	100/12.00
.1 UF DISC	100/8.00
.1 UF MONOLITHIC	100/15.00

DIODES

1N751	5.1 volt zener	.25
1N759	12.0 volt zener	.25
1N4146	(1N914) switching	25/1.00
1N4004	400PIV rectifier	10/1.00
KBP02	200PIV 1.5amp bridge	.45
KBP04	400PIV 1.5amp bridge	.55
VM48	Dip-Bridge	.35

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4.68″ Square	14.95
3.125″ Square	14.95

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TO-3 style	.95
TO-220 style	.35

SWITCHES

SPDT mini-toggle	1.25
DPDT mini-toggle	1.50
SPST mini-pushbutton	.39

CAPACITORS

TANTALUM

	8V	10V	15V	20V	25V	35V
.22uf						.40
.27						.40
.33						.40
.47				.35		.50
.68						.45
1.0			.40	.40	.45	.45
1.5				.45		.50
1.8						.75
2.2		.35	.40	.45		.65
2.7		.40	.45			.90
3.3		.45	.50	.55	.60	.65
3.9			.45			
4.7	.45	.55		.60	.85	.85
8.8			.70		.75	
10	.55	.85	.80	.85	.90	1.00
12	.85		.85	.90		
15	.75	.85	.90			
18			1.25			
22		1.00	1.35			
27			2.25			
39		1.50				
47	1.35					
56	1.75					
100		3.25				
270	3.75					

DISC

10pf	50V	.05	470	50V	.05
22	50V	.05	580	50V	.05
25	50V	.05	680	50V	.05
27	50V	.05	820	50V	.05
33	50V	.05	.001uf	50V	.05
47	50V	.05	.0015	50V	.05
56	50V	.05	.0022	50V	.05
68	50V	.05	.005	50V	.05
82	50V	.05	.01	50V	.07
100	50V	.05	.02	50V	.07
220	50V	.05	.05	50V	.07
330	50V	.05	.1	12V	.10
			.1	50V	.12

MONOLITHIC

.1uf-mono	50V	.18	.47uf-mono	50V	.25
.047uf-mono	50V	.15	.01uf-mono	50V	.14

ELECTROLYTIC

RADIAL			AXIAL		
.47uf	50V	.14	1uf	50V	.14
1	25V	.14	4.7	18V	.14
2.2	35V	.15	10	18V	.14
4.7	50V	.15	10	50V	.18
10	50V	.15	22	18V	.14
47	35V	.18	47	50V	.20
100	18V	.18	100	15V	.20
220	35V	.20	100	35V	.25
470	25V	.30	150	25V	.25
2200	16V	.60	220	25V	.30
			330	18V	.40
			550	18V	.42
			1000	16V	:60
			1500	18V	.70
			8000	16V	.65

COMPUTER GRADE

44,000uf	30V	3.95

TRANSISTORS

2N918	.50	MPS3706	.15
MPS918	.25	2N3772	1.85
2N2102	.75	2N3903	.25
2N2218	.50	2N3904	.10
2N2218A	.50	2N3906	.10
2N2219	.50	2N4122	.25
2N2219A	.50	2N4123	.25
2N2222	.25	2N4249	.25
PN2222	.10	2N4304	.75
MPS2369	.25	2N4401	.25
2N2484	.25	2N4402	.25
2N2905	.50	2N4403	.25
2N2907	.25	2N4657	1.00
PN2907	.125	PN4916	.25
2N3055	.79	2N5086	.25
3055T	.69	PN5129	.25
2N3393	.30	PN5139	.25
2N3414	.25	2N5209	.25
2N3563	.40	2N6028	.35
2N3565	.40	2N6043	1.75
PN3565	.25	2N6045	1.75
MPS3638	.25	MPS-A05	.25
MPS3640	.25	MPS-A06	.25
PN3643	.25	MPS-A55	.25
PN3844	.25	TIP29	.65
MPS3704	.15	TIP31	.75
		TIP32	.79

IC SOCKETS

	1-99	100
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
64 pin ST	4.25	call

ST = SOLDERTAIL

8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80

WW = WIREWRAP

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MAN 72	.3″	CA	.99
MAN 74	.3″	CC	.99
FND-357 (359)	.375″	CC	1.25
FND-500 (503)	.5″	CC	1.49
FND-507 (510)	.5″	CA	1.49
TIL-311 4x7	.270″	HEX W/LOGIC	9.95

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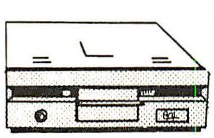
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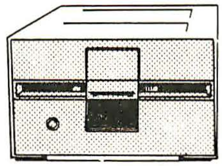
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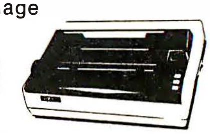
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MD110	10 SECTOR HARD, SS/SD	19.95
MD210D	10 SECTOR HARD, DS/DD	30.75
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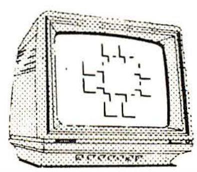
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BYTE is concerned about software piracy. Unclassified ads proposing exchanges of software must specify that the software was written by the individual or is in the public domain. BYTE reserves the right to reject any unclassified ad that does not meet this criterion.

WANTED: Donation of Apple computer system for a science department in Madras, India, for use as a laboratory computer. Dr. S. Ganapathy (visiting faculty from department of biophysics, Madras, India), Department of Chemistry, University of Minnesota, Minneapolis, MN 55455, (612) 373-2359.

WANTED: Established, nonprofit youth-athletic organization seeks tax-deductible donation of microcomputer, disk drives, monitor, and printer, or small business computer for our mailing lists, word processing, schedules, and the administration of our handicapped program. Any disk-based system would be welcomed. Kenneth Drozd, 9 Dogwood Dr., Jackson, NJ 08527.

WANTED: Nonprofit agency needs a donation of a usable microcomputer to help low-income veterans, youths, handicapped individuals, ex-offenders, and unemployment recipients attain training and employment. Bill Slovick, Project JOVE Inc., Suite 2K, 2725 Congress St., San Diego, CA 92110, (619) 238-3826.

WANTED: Nonprofit environmental organization seeks tax-deductible donation of microcomputer, disk drives, monitor, and printer. Will pay shipping. Seward Weber, Vermont Natural Resources Council, 7 Main St., Montpelier, VT 05602, (802) 223-2328.

WANTED: Donations of keyboards, monitors, printers, disk drives, and disks to promote educational opportunities for newly formed Boy Scout Troop. Donations are tax deductible. Boys range in age from 11 to 13. Donations will assist in the attainment of Computer Merit Badge and promote additional interest in computer-related Boy Scout activities. Larry Hugenberg, 3448 Belden Ave, Youngstown, OH 44502, (216) 782-5517 after 5 p.m.

WANTED: I would like to exchange ideas, suggestions, and information with other Cromemco C-10 owners from eve ywhere. Would also like to buy BYTE: August 1983 and December 1983. Orlando Lopez, Carrera 10 B, 30-28 sur, Bogota 5, Colombia, South America.

WANTED: Real-world beta-test sites needed to develop manufacturing cost-estimating program that establishes standard job costs. Managers or administrators may send a description of how your computer is equipped, what it is, and the specific cost estimating you do. If you are selected, you will receive the final package for your help. Wm. Stocker, *American Machinist*, 1221 Ave. of the Americas, New York, NY 10020.

FOR SALE: Ohio Scientific C3-B-22 time-sharing microcomputer with two 52K-ROM memories working at 2MHz for simultaneous data-handling activities. Comes with 80-megabyte hard disk, drives, and full back-up capability. Includes two Televideo 912 terminals and printer: $12,500. Will ship. Bob Harvey, Scholarship Information Inc., 5 Crystal River Dr., Cocoa Beach, FL 32931, (305) 259-9700.

FOR SALE: Back issues of BYTE from January 1982 through December 1983. Good condition: all for $50. Postage paid anywhere in the continental U.S. Send cashier's check or money order. Lee C. Boger, Apt. 251, 4555 Mission Dr., Indianapolis, IN 46254, (317) 298-4760.

WANTED: Public-domain program embodying recognized constructs and procedures from psychology and philosophy to be used by intelligent individuals to improve the quality of their professional (and personal) decisions. Mike Gallagher, 2835 West Fargo, Chicago, IL 60645, (312) 764-4737.

WANTED: IBM PC or compatible computer. Prefer smaller system or inexpensive expanded system. Minimum required: 64K, one floppy, video, parallel-printer port, operating system, and languages. Monitor, hard disk, color not important but will be considered. Include service history and manufacturer of boards. C. Reaves, Llano Route, Box 128, Fredericksburg, TX 78624, (512) 685-3256.

FOR SALE: Unused IBM PC AST Megaplus II serial/parallel clock, 64K board. Warranty card, disk, instructions are still sealed: $250 or trade. Also, have a BASF 12-Msec drive, set up for TRS-80 Model I, in OK condition: $100. Alexander Crawford, 116 East 63 St., #2C, New York, NY 10021, (516) 537-1228.

FOR SALE: Hayes Micromodem 100, S-100 modem, new: $185. SSM PBI S-100 EPROM programmer: $100. Shugart 8-inch SSDD drive, like new, can show locally: $150. Make offers. David Langmann, 2900 Conn. Ave. NW, Washington, DC 20008, (202) 232-7999.

FOR SALE: S-100 Cromemco computer 64K RAM, printer interface, 16 FDC disk controller, 21-board capacity, 30-amp power supply, three 5¼-inch Tandon DS/DD drives: $2500 or best offer. Allen Shina, 4117 New Utrecht Ave., Brooklyn, NY 11219, (212) 438-0656.

FOR SALE: Back issues of BYTE, March 1981 through December 1983. Send offer for complete set or for individual issues. Bill Efron, 1369 Murray St., St. Paul, MN 55116.

FOR SALE: Never-used Ohio Scientific system. One C1P 16K 6502-based computer with built-in BASIC. One Superboard II 6502-based computer kit (unfinished). One black-and-white monitor. Numerous manuals and a complete set of cables. Original cost was $700; best offer. Also, will consider trading for Atari or Apple equipment. Hans Hsu, 3020 Bolgos Circle, Ann Arbor, MI 48105, (313) 662-3666.

FOR SALE: *Kilobaud* #1 through #71, BYTE #1 through #60, SCCS *Interface Age* #5, 6, and 8 through #56. Make an offer. Merle Vogt, POB 145, Von Ormy, TX 78073.

FOR SALE: Two Apple III floppy-disk drives, Silentype thermal printer, super serial card for Apple II, two ADM 31 smart terminals, Intermec 9300 bar-code reader and 9400 portable bar-code reader with wands, interface, and power adapters. All manuals included. Best offer. Mark Kuster, 521 Scott Ave., Dalhart, TX 79022, (806) 249-5287.

FOR SALE: First year of BYTE: $30 plus UPS. First year of *Kilobaud*: $30 and second year: $20 plus UPS. Peter Buyaki, 203 North Cherry St., Harrison, AR 72601, (501) 741-7857.

FOR SALE: Apple Silentype printer and interface, like new. Best offer over $150. Randy Webb, 622 East 11th St., Bloomington, IN 47401, (812) 339-7661 or 335-1858.

NEEDED: College-bound student needs any computers, computer parts, printers, modems, disk drives, computer books, CRT terminals, peripheral cards of any kind, and anything else. I will pay all postage. Doug Peterson, 5555 Washington, Denver, CO 80216, (303) 296-0346.

WANTED: Texas Instruments operating systems for obsolete DS990/1 with FD-1000 and 771s with FD-800 (also obsolete). Need TX5, TX5DS, and TXDS. Can swap TX5 or TX5DS manual for system configured to come up on my unit. Also, need documentation for TPL release 3.2. Robert Geeslin, 1142 East 49th St., Tulsa, OK 74105.

WANTED: College student would appreciate a donated computer for experiments. Kevin Knott, 26347 Midway, Dearborn Heights, MI 48127.

WANTED: High school student would like donated Apple computer equipment, cards, peripherals, manuals, anything unwanted. Will pay all postage. Anthony Mate, 4769-B, West 120th St., Hawthorne, CA 90250, (213) 978-8917.

FOR SALE: BYTE from Vol. 3 No. 4 to Vol. 9 No. 1. Missing Vol. 3 No. 5 and Vol. 4 No. 1. Best offer for all. Sanford Spero, Apt. 7, 503 North Grant, West Lafayette, IN 47906, (317) 743-8806.

WANTED: Student who wants to enter telecommunications would appreciate any donations of modems or modem parts in any condition. I will pay shipping costs. Paul Hopkins, 289 Goose Lane, Tolland, CT 06084.

FOR SALE: Back issues of BYTE, January 1979 through December 1983 complete. Good condition. Best offer over $100. Jim Shearer, Suite 2, 210 West Maumee, Angola, IN 46703, (219) 665-7673.

WANTED: Unwanted or broken computers, disk drives, printers, or modems. I will pay shipping and handling costs. Robert Haskins, R.D. #3 Box 3611, Spring Grove, PA 17362.

FOR SALE: Back issues of BYTE, September 1975 through December 1983, except October 1975 and January 1976: $350 or best offer. Back issues of *Interface Age*, December 1976 through June 1981: $200 or best offer. Bill Myers, 98 Pineland Dr., Akron, OH 44321, (216) 687-2982.

WANTED: S-100 boards for Technical Design Labs Xitan computer. Especially interested in memory boards and the ZPU-2 microprocessor board and associated documentation. Send description with asking price. William Leonard, 14956 Ronda Dr., San Jose, CA 95124, (408) 377-8582 evenings.

WANTED: Atari 810 disk drives, new or used. David Allbritton, POB 6811, Birmingham, AL 35210.

WANTED: Anyone interested in exploring the uses of personal computers for some not-so-common applications. Let's correspond. I am an engineer. Amy Mehta, 4026 Harvest Hill #2043, Dallas TX 75234, (214) 620-0831.

FOR SALE: Xerox 820 board. Comes with CP/M 2.2 and Microsoft BASIC on an 8-inch disk. Without monitor, drives, or enclosure: $50 as is. Also, BMC composite monitor: $75. Joe Keller, 10110 Walnut St. #216, Dallas, TX 76243.

WANTED: Graduate student would appreciate donated computer and peripherals for experiments. I will pay shipping. Fonbin Lin, 35 Northwood Rd., Storrs, CT 06268, (203) 487-1735.

WANTED: Early issues of *Micro*, *Kilobaud*, and *6502 Users Notes*, circa 1977 through 1980. Also interested in obtaining a Texas Instruments TM 990/U89 University Board. Harold May, 428 Phillippa, Hinsdale, IL 60521, (312) 325-1910.

FOR TRADE: Rainbow 100 users interested in swapping information and ideas. A. Darveau, Room 807, 3655 Drummond St., Montreal, Quebec H3G 1Y6, Canada.

WANTED: If interested in joining a users group for Timex/Sinclair computers on Long Island, drop me a post card. Heinz O. Henken, 9 Dartmoor Dr., East Northport, NY 11731.

FOR SALE: CompuPro hardware, 816A system, 20-megabyte hard-disk subsystem. Extra RAM 21, M-Drive/H, 10-MHz CPU 86/87, MPX-16. All like new. Visual 300 terminal. Also, Ithaca Intersystems Model 810H computer with front panel and XPU-80 6-MHz Z80B CPU. In perfect condition. New, over $13,000; $4000 takes all. Frank McGirt, 188 Piedra Loop, Los Alamos, NM, 87544, (505) 672-9362.

FOR SALE: Tektronix T4002 graphics computer terminal with 4802 joystick, high-speed RS-232C interface, two spare tubes, all manuals. 1K by 1K addressable points. Recently calibrated. Excellent for CAD/CAM work: $2000, trade, or make an offer. Bob Morein, 1570 Arran Way, Dresher, PA 19025, (215) 646-4894.

FOR SALE: Radio Shack PC-1 Pocket Computer and printer/cassette interface that allows up to 1424 BASIC statements. Manuals included. Also, have cassette recorder used for storing programs and data. All in excellent shape: asking $170 (with optional cassette). Would like to trade for an HP41CV. Steve Gentry, RR 1, Box 481, Richland, IN 47634, (812) 359-5170 evenings.

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Steve Ciarcia's "Build a Scrolling Alphanumeric LED Display" placed first in BYTE's Ongoing Monitor Box results for April. Ciarcia and his Circuit Cellar will benefit from the $100 prize. "The Coleco Adam" by Jules H. Gilder wins $50 for second place. In the third slot is Jerry Pournelle's User's Column: "The Most Fabulous Object in the Entire World." Ruth Heuertz, author of "Soviet Microprocessors and Microcomputers," is fourth in the countdown and in fifth place is Gregg Williams's preview of "The Mindset Personal Computer." Congratulations, authors.

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17	39	61	83	105	127	149	171	193	215	237	259	281	303	325	347	369	391	413	435	457	479	501	523	545	567	589	611	633	655	677	699	721	743	765	787	809
18	40	62	84	106	128	150	172	194	216	238	260	282	304	326	348	370	392	414	436	458	480	502	524	546	568	590	612	634	656	678	700	722	744	766	788	810
19	41	63	85	107	129	151	173	195	217	239	261	283	305	327	349	371	393	415	437	459	481	503	525	547	569	591	613	635	657	679	701	723	745	767	789	811
20	42	64	86	108	130	152	174	196	218	240	262	284	306	328	350	372	394	416	438	460	482	504	526	548	570	592	614	636	658	680	702	724	746	768	790	812
21	43	65	87	109	131	153	175	197	219	241	263	285	307	329	351	373	395	417	439	461	483	505	527	549	571	593	615	637	659	681	703	725	747	769	791	813
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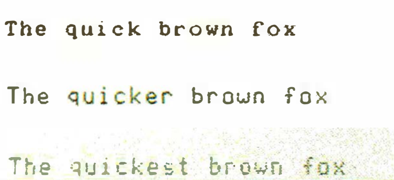
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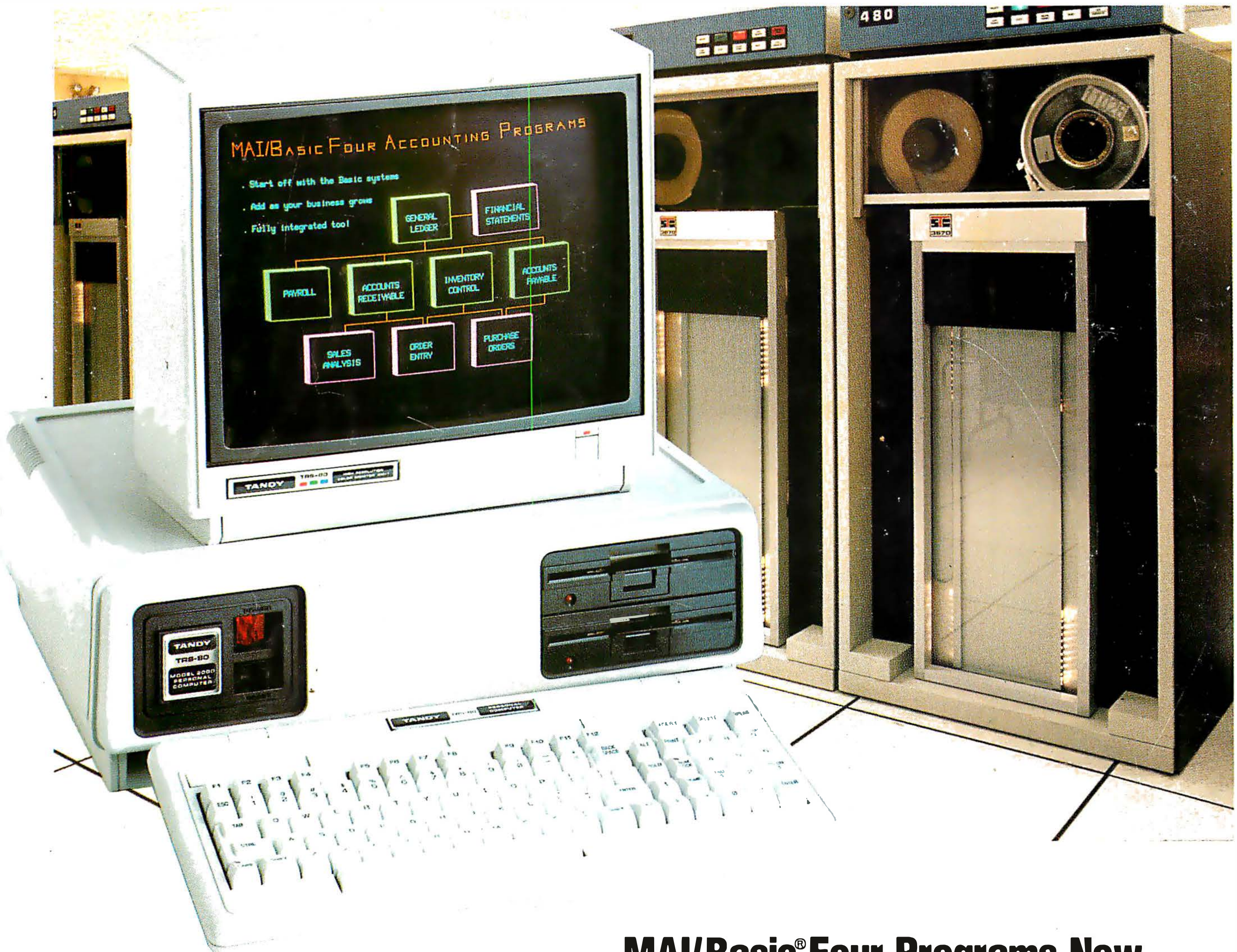
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